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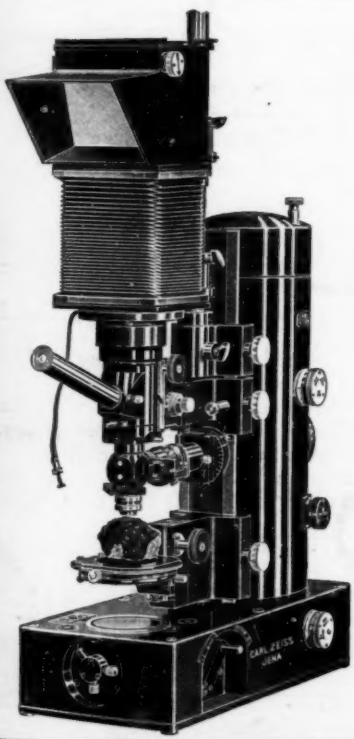

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CURRENT SCIENCE

Vol. V] June 1937 [No. 12

India's Livestock.

THE Cattle Conference recently summoned by H. E. the Viceroy at which provincial ministers and official scientific experts were present, adopted a series of resolutions covering practically the entire range of subjects discussed by the delegates. The most important among these resolutions deal with the establishment in each province of a Provincial Livestock Improvement Fund, a Livestock Improvement Board and the closest co-operation between the several ministeries and sub-committees. These resolutions have an obvious reference to the administrative control of the measures to be adopted for the improvement of cattle. In evolving the means to achieve the desired improvement, another set of resolutions dealing with the provision of grazing facilities and the appointment of competent staff for the purpose of implementing the recommendations of the Conference, were enthusiastically adopted. These resolutions were preceded by two illuminating speeches made by the Viceroy and the Member in charge of Education, Health and Lands, which give a comprehensive survey of the problems underlying the programme of work recommended to the provincial governments for adoption. In elaborating the schemes necessary for the improvement of livestock, the Member in charge of Education claimed that a big forward step has already been taken by the Central Government in the appointment of the Animal Husbandry Experts and the establishment of various research stations where higher courses in veterinary science are to be organised. On the subject of financing the various schemes contemplated by the resolutions of the Conference, the provincial ministers did not, however, receive any assurance from the Central Government of subsidies.

It seems to us that the problem of the improvement of Indian livestock is as great and complex as that of the improvement of the population of the Indian Empire. In a recent broadcast speech Mr. E. R. Smythies, Conservator of Forests, United Provinces, pointed out that India has not merely the largest cattle population of any country

in the world, but it has so much the largest that no other country can hope to compare with it. In fact to approach the Indian stock of bovine cattle, we have to group continents together, for even excluding Burma, the rest of the Indian Empire has an inconceivable number of 200 million head of cattle,—a total that exceeds the combined bovine population of North-West Europe, North America, South Africa and Australia. The density of this population in India is heaviest in the United Provinces which exceeds that of any other province by 20 per cent. For that matter the cattle population of the United Provinces alone, about 32 millions, is far in excess of the combined total of three Dominions of the Empire, *viz.*, Canada, Australia and New Zealand. This stupendous magnitude of the herd must be too baffling for any enterprising statesman or a syndicate of ministers to embark upon the colossal task of its improvement even in any single direction.

Domesticated cattle have had a direct and vital bearing upon the welfare, activities and destinies of the human society. Indeed the biologist finds it difficult to believe that there would ever have been a human race had there been no other mammals, and even if man had come into existence independently in the absence of other mammals, we might well imagine that the historical development of his civilisation would have proceeded along some unknown lines, and probably the final results would have been far different from what they are to-day. The honours of human civilisation are shared equally by the ox and the cow, though the contribution of the horse to its evolution must be considerable. The human race would have been utterly unable to progress from its primitive to its present enlightened state, if the domesticated mammals did not furnish it with meat, milk, butter, cheese, cream, leather and other products or did not draw the ploughs and loaded waggons or did not help groups of population to migrate and colonise.

The explanation of the remarkable growth of cattle population in India is to be found in the peculiar sanctity in which the cow and the ox are firmly enthroned in the Hindu pantheon. But while surmising that these animals may have come to a place of honour from early and poetical association with myths of sun and rain, it is also possible to regard their dignity from a merely human and reasonable standpoint. The paramount importance of protecting and preserving animals absolutely indispensable for the welfare and prosperity of the community might have imposed on its members, otherwise careless of the future, the superlative necessity of treating them as objects of veneration, amounting to religious injunction. Under this reverence for the ox and the cow, which is a sacramental ordinance, they multiplied in the early days of Hindu dynasties before Indian history was changed, when the customary honours for them maintained by formal prescription naturally diminished. In spite of the veneration, sanctioned by centuries of usage and tradition, cows and oxen have not escaped barbarous treatment resulting frequently in permanent dislocations of either their limbs or tails. The fact is that the greater part of Indian teams is not trained, and, being unable to understand the command or being too weak to bear the load, they incur heavy displeasure from their owners.

The improvement of livestock is really a chapter in economic mammalogy, and its problems extend into the fields of genetics, with corridor contacts with the chemistry of animal nutrition and immunology. The Conference has not defined the expression "Improvement" in specific terms, but it may be presumed that the Indian cattle have to be improved all round, producing a race hardy and enduring, with an excellent hide, possessing rich meat, yielding a plentiful supply of milk, and endowed with considerable power of resistance to diseases. These qualities in the local breeds are not to be achieved by crossing experiments alone, for they are only a part of the general science of animal eugenics. The most important problem which confronts the livestock improvement boards must be the source from which fodder has to be obtained for the millions of cows and bullocks which form an integral part of the human society. Mr. Smythies informs us that the forest areas under the Forest Department are only 5 per cent. of the total area of the United Provinces and contribute very little of the grand total of fodder

requirements, since less than one million of all these millions of cattle ever go near the forests. In calculating the total demand for fodder in the United Provinces, he reaches the conclusion that, assuming each head of cattle requires 2 tons per annum, we have to provide 56 million tons of fodder per annum for the whole bovine population. It is easy to have an estimate for the whole Indian team of 200 millions. Closely connected with the fodder problem is the question of supply of fuel to the people who depend upon the cattle dung not only for domestic use but also for the purpose of village industries which require high temperature for their activities. The solution of these immense problems is as difficult as the provision of adequate supply of sufficiently nutritive and wholesome food to the entire human population in India. It is true that an increased supply of fodder per animal can be obtained either by reducing the total number of cattle so as to enable the better fitted ones to get more or by increasing the total supply. In the former case the source of supply of manure and fuel becomes restricted, and in the latter, more land has to be brought under cultivation of fodder grass, which is rendered difficult on account of the increasing demand for extending the zones of rice and wheat cultivation for human consumption.

Far more pressing and important than the quantitative aspect of the problem of fodder supply, is the chemistry of animal nutrition. While we have a reliable body of knowledge of the various proximate principles of food used by man, their physiological reactions and nutritional values, the chemistry of food and nutrition of cattle is still a virgin field. What we have chiefly to consider at present is that the normal affairs in the body of the ruminant animals is not such as may be called a point or a line, but must be regarded as a zonal environment whose superior condition and nutritional well-being can be maintained by the interplay of food and the potential physiological resources of the given individual. Previously chemical researches have shown many instances of highly effective regulatory processes in the body, maintaining physiologically stable conditions, and such automatic regulation is necessary for life processes : but modern investigations reveal that certain quantitative chemical relationships in what is introduced into the animal body may keep the actual condition of the internal environment within the more favourable part of that wider range which the automatic regulatory process permits. We want a precise and carefully tested body of information on the chemistry of the food of cattle and on the physiological reactions evoked by its constituent parts, on which to base the experiments of breeding.

In any scientific plan of breeding experiments, the conditions under which the new race has to live and propagate must inevitably produce an effect favourable or adverse to the interests and purposes of the experimentalist, according as these factors of environment are favourable or hostile for the parents. Further it is a well-established fact that some variations are from the first so stable that their persistence is certain without any precautions of inbreeding. But in other cases it appears to be the experience of breeders that a period of inbreeding with elimination of the undesirable characters that may crop up, serves to fix the desirable ones developing prepotency in their favour. It is true that some stable and important breeds of cattle, for instance, polled Augus, have arisen under conditions involving in the early stages extremely close breeding, and it is well known in horse-breeding that very valuable results have been reached by using the same stallion repeatedly on successive generations.

The whole subject of inbreeding and outbreeding must necessarily underlie a close investigation of the study of the chromosomes of the local races. The results of inbreeding experiments are often puzzling, for they as often fix the desirable qualities as they expose the undesirable characters. The value of exogamy or outbreeding is mainly to introduce a greater variety of raw material on which selective agencies can work. It also promotes "hybrid vigour," by the pooling of diverse hereditary resources of good quality.

Closely associated with the investigations of the chromosomes of the germ cells of the different breeds of cattle in India, is the wider and more difficult problem of the climatic and dietetic

influence on the hybrids. As important or perhaps more important than the breeding experiments of cattle, is the education of the agriculturist and the cattle owner to whom Governments propose to entrust the new breeds produced under their auspices for tending and protecting them.

It seems to us that before launching upon expensive experimental measures, the Government of India may take advantage of the presence of some of the reputed authorities on the science of animal genetics and animal nutrition, visiting India during the next cold weather, for consultation with their own experts on the various schemes devised for the improvement of Indian livestock. To our mind the problems seem most involved, and they have numerous lines of side enquiries, and they have every chance of being hopefully inaugurated, after an extensive and critical examination of their implications by foreign experts whose knowledge and experience in this field of enquiry must be of inestimable value in planning experiments or in obtaining desirable results.

The Production of Food-stuffs, Alcohol and Glucose from Wood by means of the Bergius-Rheinau Process.

By Friedrich Bergius, *Heidelberg.*

THE chemical reaction upon which wood saccharification is based has been known for more than a century. But it is due to technical experiences, gained within the last two decades only, that these chemical possibilities could be put to practical and economical use.

Fundamentally, there are two ways to accomplish the dissolution of the organic substances contained in the wood: the use of dilute acids at high temperatures and corresponding pressures, or the use of highly concentrated acids at low temperatures and pressures.

The former method failed on account of the considerable loss of wood substance, a further disadvantage of this working method being the fact that the sugar is produced in the form of thin solutions. The latter method has thus far proved a failure because of the impossibility of recovering the large amount of acid used.

A method, therefore, which avoided these deficiencies, could only be reckoned with to become a commercial success. For it is essential that an ideal large-scale process transforms practically the whole of the wood treated into usable products and, if the reaction is brought about by means of concentrated acid, recovers most of the latter.

Unlike the endeavours in other fields of chemistry, the chemical methods of treating wood are still rather behind time in regard to the exploitation of the many valuable components contained in this raw material. Due attention is rarely paid to the question of how loss of substance is to be avoided. The reason most likely is that it has not been until relatively late that wood began to be seriously regarded as raw material for chemical processes.

During recent years only, an increased activity is to be recorded on the different fields of wood chemistry in regard to improved working methods and the manufacturing of high-grade final products, though it must be admitted that in most processes a large percentage of the wood is lost during the treatment. Wood distillation, for instance, produces about 60 per cent. of useful materials (35 per cent. of charcoal, 25 per cent. of volatile substances), the balance being lost. The pulp industry recovers about half the wood in form of pulp while the other half is not only lost but has to be eliminated from the process with considerable difficulties. The industries extracting resins and tanning materials from the wood must be satisfied with an even smaller percentage while up to 90 per cent. of the wood can only be used as fuel.

This problem of transforming practically the whole of the raw material into valuable products has been most satisfactorily solved by our own wood hydrolysis process, the so-called Bergius-Rheinau Process.

In painstaking co-operation covering a period of many years, my collaborators and I succeeded in building up the chemical basis of the process and in working out the technique to carry the process through satisfactorily.

Before entering into a description of this process, let me state that, when we began to work on wood hydrolysis, our starting point was not a scientific but an economical problem.

It was the beginning scarcity of food-stuffs in Germany in 1916 that made us turn our attention to a way of alleviating the deficiencies described above by adapting the saccharification of wood to the production of a concentrated and digestible sugar, or mixture of sugars, fit for human consumption in the form of pure glucose or of a highly nutritive carbohydrate to be used as cattle food.

With this end in view, we had to exclude as disintegrating agents dilute acids, which do not allow the production of concentrated sugar solutions, as well as concentrated sulphuric acid. For there is no large-scale method to separate concentrated sulphuric acid from the sugar formed without loss of sugar. As already mentioned, the economy of a process, however, in which concentrated acid is used in large quantities, necessitates the recovery of this acid.

It was for this reason, that we at last chose the chemical reaction, found by Willstätter and Zechmeister a few years before, of dissolving cellulose in 40 per cent. hydrochloric acid, and set to work to develop this reaction into a technical process after we had made sure that a method for the recovery of the concentrated hydrochloric acid could be found. So the working out of this method really has been the first important problem confronting us, and it took us a number of years to arrive at the present method of distilling off the hydrochloric acid under vacuum.

It takes seven parts of hydrochloric acid of 40 per cent. strength for one part of wood to produce the largest possible amount of sugar.

The acid is applied to the wood at normal temperatures. It is essential that an increase of temperature is avoided because heat easily causes the sugar formed to be destroyed.

The economical workability of the process was established beyond doubt only after we had found that a sugar-containing acid-solution is able to react with fresh wood, thereby increasing its sugar concentration, which led us to develop a kind of diffusion process akin to the one used in beet-sugar manufacture.

Working of the Bergius-Rheinau Process.

The process, a diagram of which is given in Fig. 1, is conducted in a battery of diffusers with a capacity of from 20 to 40 cu.m. each, ten of which are joined to one working unit.

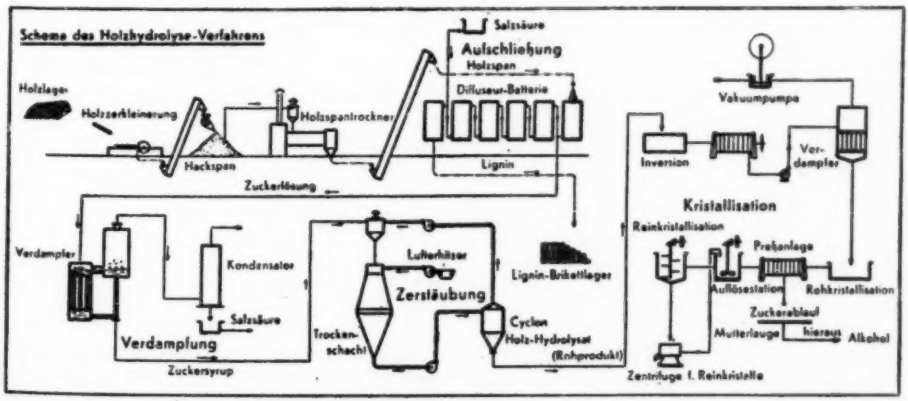


Fig. 1.
Diagram of the Process.

Great difficulties were experienced in building these diffusers so as to resist the corrosive influence of the concentrated hydrochloric acid. From the glass tubes of the laboratory by way of the stone-ware apparatus of the experimental plant and the so-called Prodorite vessels of the semi-technical plant, we arrived at last at the pres t diffusers built of iron and lined with a special acid-resisting material. After some years of continuous running, these diffusers are not showing the least sign of corrosion.

The wood which normally contains from 20 to 40 per cent. of moisture is first shredded into suitable pieces about the size of a kernel of corn. Saw-dust may be added to this material up to 25 per cent. The wood is then dried in a revolving drum until it contains only about 8 per cent. of moisture.

After treating the wood in the pre-mashing apparatus mentioned with a solution containing sugar and hydrochloric acid, it is dropped in at the top of the first diffuser while the concentrated hydrochloric acid is introduced into the last diffuser entering at the bottom and, after a certain time allowed for the hydrolysis to take place, flowing over into the next vessel and so on, the liquid coming into contact with fresh wood in every diffuser. After having thus passed through the whole battery, it is drawn off from the first diffuser and transported to the distillation plant in form of a 32 per cent. of sugar-containing solution. The hydrochloric acid is brought to the regeneration plant to be recuperated to its former strength by the addition of HCl gas and then returned to the process.

During the treatment, two-thirds of the weight of the wood is dissolved by the acid, and one-third remains in the vessels in form of lignin. After the hydrochloric acid has been systematically washed out, the now neutral lignin is easily removed by opening the vessels at the bottom. The lignin can be used as fuel for the plant, but as it is practically free of ashes, easily briquetted without the addition of a binder and has other special qualities besides, it can be more profitably used for the most varied purposes as will be shown later on.

The next phase of the process is the separation of the sugar from the hydrochloric acid which now, after a number of years of research work, is effected by distillation under vacuum at a temperature of about 36°C. The hydrochloric acid is evaporated and used again after condensation and regeneration. The distillation plant consists of a totally acid-proof apparatus of evaporators with tubes made of a special ceramic material of good heat conductivity (Fig. 2).

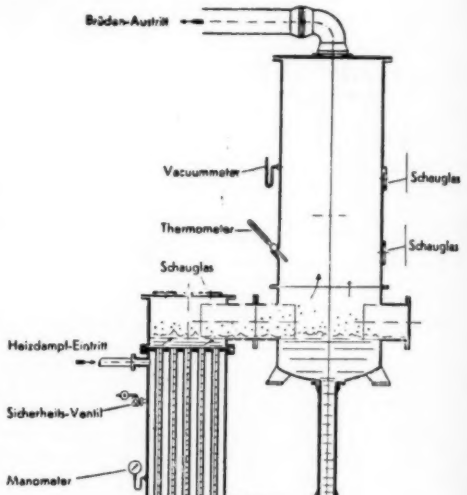


Fig. 2.
Diagram of Tubular Evaporator.

The most difficult problem in constructing this apparatus was finding an arrangement to avoid the dangerous effect of the different heat expansion coefficients of the ceramic and the iron parts. We now have an equipment for the distillation and condensation of hydrocaloric acid under vacuum which operates satisfactorily and can be built in large units. No corrosion or leakage has taken place during some years of running the plant.

After leaving the distillation plant, the syrup, now containing 55 to 65 per cent. of sugar, is dried in a spray diffuser, hot

air being brought into contact with the finely atomized concentrated solution and evaporating the hydrochloric acid and water (Fig. 3).

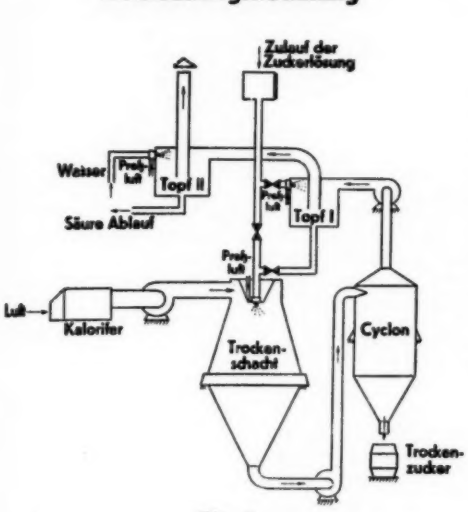


Fig. 3.
Diagram of Spray Drier.

A solid product, containing 1 to 2 per cent. of HCl, about 8 per cent. of water and 90 per cent. of sugars, is collected in cyclons.

At the same time, the acetic acid contained in the wood is distilled and condensed together with the hydrochloric acid. In a special apparatus it is then separated from the latter.

Practically, no loss of sugar occurs during the reaction as every possibility of decomposition due to increase of temperature is excluded.

THE RAW MATERIAL OF THE PROCESS.

The Bergius-Rheinau Process can use every kind and every quality of wood, coniferous wood or wood from foliaceous trees, waste wood from the forests or the waste of the timber industries. Unlike for the production of pulp, the condition of the cellulose fibre is of no account in our process. Whether the wood to be treated is coming from young or old trees, whether it be fresh or stored, sound or rotten, it makes good raw material for our hydrolysis process. The mixture of the carbohydrates produced will, of course, be differently composed the same way as the carbohydrates differ in the wood before undergoing treatment. The output of alcohol or crystallised glucose, however, is not to any considerable extent influenced by these differences in composition.

The Bergius-Rheinau Process can be conducted according to the chemical components of the wood to be treated. Wood with a large amount of resins or tanning substances will be treated with suitable solvents before submitting it to the hydrolysis process. The pentosanes of the wood of foliaceous trees likewise are first extracted by means of dilute acids.

In most countries, the raw material of the process is to be had in abundance. India's forest area, for instance, is about 80 millions of hectares, *i.e.*, 27·5 per cent. of the total land area, about the same percentage, by the way, as in Germany.

THE PRODUCTS OF THE PROCESS.

The solid raw sugar, the primary product of the process, contains—depending on the sort of wood used—glucose, mannose, xylose, galactose and fructose, mainly in tetrameric form. Polymerisation from the monomeric to the tetrameric form takes place in the run of the process between the diffusion battery and the spray drier. The total yield of the different sugars amount to from 60 to 66 per cent. of the original dry wood substance, thus practically equalling the theoretically possible output.

By means of an inversion process, these sugars can easily be transformed into a fermentable solution.

The dry wood sugar, a pure carbohydrate, can, after neutralising the small amount of acid with lime, be used as fodder—especially for pigs and poultry—either by itself or in mixture with other fodder such as barley or dried potato chips. Extensive tests carried through by official institutions over prolonged periods, proved the fact that the feeding value of this raw wood sugar is equivalent to that of barley.

Containing a small percentage of hydrochloric acid, the dry wood sugar, as has been found by experts, is an exceedingly effective means of securing the preservation of green fodder in soils.

By the usual fermentation process, alcohol can be produced from the wood sugar. 200 kilograms of raw wood sugar yield 100 litres of pure 100 per cent. alcohol, *i.e.*, about 50 liters per 100 kilograms of reducing sugar.

The xylose contained in the sugar solution cannot be fermented by employing yeast, and galactose can only be fermented under special conditions. They remain in the spent wash which in being used over again is more and more enriched. The wash is then evaporated and the residue dried in a spray drier into a stable product without the addition of mineral acids. This product can also be used as cattle food or for other purposes.

By this method, about 80 per cent. of the raw sugar are converted into alcohol while the remaining 20 per cent. are recovered as other useful material.

It is obvious that the raw wood sugar can also be used for other fermentation processes yielding, for instance, baker's yeast or fodder yeast and lactic acid. From 100 kilograms of fermented sugar, 50 kilograms of dry yeast containing about 55 per cent. of albumen are produced. Accordingly, 25 kilograms of dry yeast containing about 13 kilograms of albumen are obtained out of 100 kilograms of wood.

About one-third of the raw wood sugar can, by an inversion—and crystallisation—process, be transformed into chemically pure crystallised glucose or crystallised xylose, the former being the more important of the two. The inverted raw sugar solution is neutralised, filtered and concentrated and can then be easily crystallised. By re-crystallisation, a white and very pure dextrose is obtained.

The mother-liquor, still containing some glucose, mannose and other sugars, can be fermented or used as fodder. In this way, no sugar is lost. By a special method of conducting the process, xylose also can be recovered in crystallised form.

Out of the xylose solution, furfural, a high grade solvent for refining resins or crude oil, can be produced. It can also be used for the production of artificial resins and organic acids or transformed into other solvents of special properties.

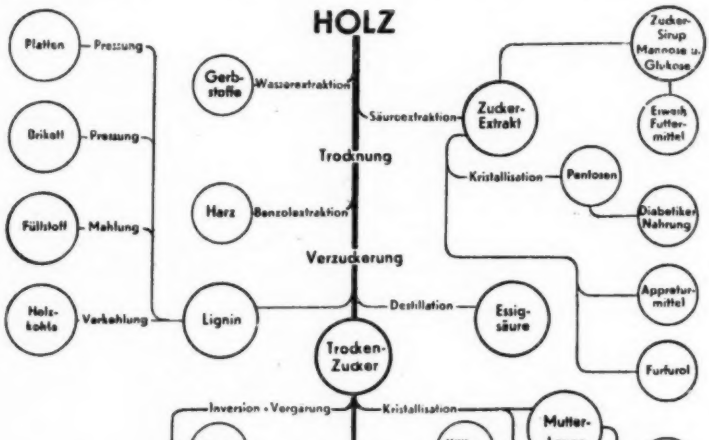


Fig. 4.
Diagram of the Products.

Besides the products mentioned, a number of others can be produced from wood sugar, for instance, some special kinds of sugar for pharmaceutical and different technical purposes, glycerin, tanning substances and resins.

BY-PRODUCTS.

Lignin, one of the by-products of the process, consisting of the non-hydrolysable substances of the wood, is produced to the amount of 33 kilograms per 100 kilograms of dry wood substance. As has been mentioned, it can be used for the most varied purposes. Briquetted lignin, for instance, can be turned into a hard and uniform charcoal of good quality and both, lignin briquette and lignin charcoal, being free of acetic acid, are suitable fuels for the modern wood-gas generators.

The other by-product of the process, acetic acid, is recovered to the amount of 2 per cent. when treating coniferous wood and of 5 per cent. when treating wood from foliaceous trees. Technical acetic acid is not only used as solvent and raw material for the production of esters but for various other purposes.

A diagram of the products obtained by the Bergius-Rheinau Process is shown in (Fig. 4).

In judging the economic value of the process, the fact that it recovers, as has been shown, nearly 100 per cent. of the wood treated in form of valuable products, is of considerable importance.

Food Adulteration in the Madras Presidency.

By Herbert Hawley, M.Sc., F.I.C.
(*Government Analyst for the Madras Presidency.*)

I PROPOSE to give some account of the working of the "Prevention of Food Adulteration Act in the Madras Presidency". It is a fact that very little information is published as to the working of this and similar Acts in other provinces, and I hope that this short account of the working of the Madras Act may induce Government analysts in other provinces to give a similar account of their activities in their own areas. There is plenty of information available on the working of the Food and Drugs Act in England. All public analysts there are under statutory obligation to publish quarterly reports; in practice most of them publish annual reports as well and preces of these can be found in many scientific journals.

If the reports of analysts in India could be studied, it would be found that the position is entirely different from that of England. In England, analysts usually report some small percentage, say 3 to 5 per cent. of their samples as adulterated. But, if one comes to look further into the matter, one finds that the bulk of this adulteration is due to the infringement of certain rules that have been prescribed in the interests of public health, *e.g.*, certain preservatives in food are prohibited; others may only be used to preserve specified foods and then only subject to a maximum proportion being used. Gross adulteration by shop-keepers, for example, the mixing of margarine (imitation butter) with butter is almost non-existent. In India,—I can only speak for Madras, but I imagine that other provinces show similar results—gross adulteration of staple articles of food is met with in every area in which the Act is worked. The Madras Act is in force in about 60 local areas including the City of Madras. Between 6,000 and 7,000 samples a year are examined and of these more than a third are found to be adulterated. During last year in the Madras Presidency, of 6,581 samples taken the percentage of adulteration was 67·2% in milk, 33·1% in ghee and 10·9% in oils.

Bad as the figures are for ghee and oils, they show a definite improvement on previous years, and one looks forward with some confidence to some further improvement. This is due to a change in policy

in dealing with food adulteration. When the Act was first brought into force seven years ago, it and the Regulations made under it, were based on the English Acts. Thus fairly complicated regulations were prescribed for the labelling of commodities which the vendors wished to sell as mixtures. The Regulations also prescribed that when a vendor was selling such an article to an illiterate, he must give the same information by word of mouth. In practice these regulations were a complete failure. It became the practice of ghee merchants to label all their vessels with a notice stating that they guaranteed some trivial proportion of ghee, usually 3 or 5 per cent. As it was obvious by mere taste or smell that actually a large proportion of ghee was present purchasers accepted the vendor's explanation that these labels were meaningless and were simply displayed to meet the requirements of the Regulations. In this way heavily adulterated ghee could be sold as genuine ghee. Similar difficulties arose in connection with gingelly oil which was at one time very heavily adulterated with the cheaper groundnut oil. The requirement that these notices should be explained to illiterates was completely ignored and it was found difficult to obtain witnesses to substantiate a prosecution for infringing the rule. The adulteration of ghee and gingelly oil is now prohibited and mixtures may not be sold or stored for sale under any designation. This rule has been in force for more than a year in connection with oil and adulteration has fallen from 28% in 1933–34 to 11% in 1935–36. A similar rule for ghee was in force for 9 months during the last year for which complete figures are available and ghee adulteration which was at one time as high as 53% fell to 33%.

Milk adulteration remains steady at a very high figure. As milk is sold very largely by itinerant vendors, who, following a conviction, will usually change their district, it is not possible to drive a persistent offender out of business as is possible with residential shop-keepers. I have recommended to Municipalities that they should adopt by-laws requiring registration of milk hawkers whose licence would be liable to withdrawal following a conviction. If my recommendation is accepted it will be interesting to see whether it causes an improvement.

Though the Madras Act can be applied to all food-stuffs I have recommended sampling officers to confine themselves, for the time being, to staple articles of food such as milk, ghee, butter and gingelly oil, and these commodities make up a large proportion of the samples examined here. I propose to give a few notes as to the methods of analysis used in connection with these and a few other commodities and the prescribed standards, where they exist.

Milk.—Under the rules it is laid down that buffalo milk should contain at least 9·0% solids-not-fat and 4·5% fat and cow milk 8·5% solids-not-fat and 3·0% fat. There are supplementary standards for nitrogen of 0·53% for buffalo milk and 0·5% for cow milk. These latter standards are intended to be used when decomposition takes place and it is not possible to estimate the proportion of solids-not-fat orginally present with any accuracy. When a sample is decomposed it is treated with a few drops of strong caustic soda, warmed, and mixed. It is then easy to get uniform sample and it has been found that the proportions of fat (estimated by Rose Gottlieb) and nitrogen in such a sample are, for all practical purposes, identical with those in the original milk. In connection with the Madras standards it should be noted that, as with all similar standards, all they do is to transfer the onus of proof of adulteration to the Analyst when the sample complies with the standards. With heavily adulterated samples the proportion of adulteration is calculated from the deficiency below the standard figures, but in the case of border-line samples either above or below the standard, freezing point determinations are made with the Hortvet Cryoscope. This of course gives an exact figure for the proportion of added water, and it is frequently found that samples which by comparison with the standards would be passed as either genuine or but slightly adulterated or actually heavily adulterated. This arises from the fact that milks, and buffalo milk in particular, frequently contain 10 or even a higher percentage of solids-not-fat. When we commenced freezing point determinations one minor difficulty had to be overcome. In Madras, Inspectors are instructed to add a small quantity of formalin (40% formaldehyde) to their samples

to preserve them in transit. Formaldehyde has of course a very low molecular weight and accordingly quite small quantities have a very large effect on the freezing point. To remove the formalin, our procedure is as follows:—About 90 mils. of milk and about 10 grams of paraffin wax (to minimise frothing) are placed in a distilling flask which is counterpoised. About 40 mils. of water is then distilled off. The flask is cooled and brought back to its original weight with water. It is found that all free formalin comes off in the distillate. The residual milk will, on acidification, give colour tests for formalin, but this residual formalin appears to have condensed with the proteins of the milk as it is found that milk evaporated and brought back to its original weight in this way has a freezing point almost identical with that of the original milk.

Ghee and Butter.—In Madras there is a limit of 20% of moisture for butter. The determination of moisture is, of course, analytically very simple. On the other hand, it is laid down that butter and ghee must be prepared exclusively from milk or cream, and further the addition of foreign fat to either commodity is prohibited. To express a confident opinion as to whether a sample of ghee (the same thing applies to butter-fat) is genuine, frequently involves a very large amount of work. Though ghee has an average Reichert value of about 32 or 33 many samples give figures as high as 40; on the other hand, even bulked samples can give figures as low as 28. *N.B.*—In these notes I am ignoring ghee prepared from the small yield of milk given by buffalos which are nearing the end of the period of lactation. From such samples very low figures can be obtained, but, in view of the relatively small yield, the presence of one or two such animals in a herd will have very little effect on the figure for the bulked sample.

When the Act was first introduced samples were normally either unquestionably genuine or heavily adulterated and in the majority of cases a Reichert determination alone was sufficient. The position has now changed entirely. The ghee merchants themselves employ semi-skilled chemists who can make routine analyses, such as the determinations of Reichert Values and Refraction, and who are competent to advise their employers as to the preparation of mixtures which will give the maximum probability of the sample being classed as "border-line" and passed as genuine. In these circumstances and in view of the great variability in the figures for Reichert Value and Refraction, it is obvious that no sample can be passed as genuine without further investigation unless it yields a Reichert of over 30; and even in these cases some further investigation should be done if there is any appearance of lack of correspondence between the Reichert Value and the Refraction. The supplementary figures I rely on mainly are titre of the insoluble fatty acids, melting point of the sterol acetate and a determination of *iso*-oleic acid. An adulterant, which has recently come into popularity is a very much hardened hydrogenated fat. I believe this is popular because it has a lower refraction than the ordinary vegetable fats of moderate consistency. It is also a fact that, due to the high degree of hydrogenation, most of the sterol has been destroyed. Accordingly, if a sample of buffalo ghee having a high Reichert Value is adulterated with a small amount, say 20% of such adulterant, the fact of adulteration will not be detected by the Reichert, Refraction or melting point of the sterol acetate. On the other hand, this particular form of sophistication is easily found out by a determination of the titre of the insoluble fatty acids. The Titre figure for genuine samples of ghee normally lies between 40° and 42°. Figures over 42°·5 are very rare and I have yet to meet a sample with a titre exceeding 43°. On the other hand, the adulterated samples usually give a titre of over 43° and figures up to 45° have been recorded. If, when the presence of this adulterant is suspected, the titre gives a border-line figure, it becomes necessary to determine the proportion of *iso*-oleic acid before one can give a definite opinion. Ordinary vegetable fat of the consistency of genuine ghee increases the Refraction considerably and if this increase is not high enough to be conclusive one can give a definite opinion after determination of the melting point of the sterol acetate, as these substances contain a considerable proportion of phytosterol. The highest melting point obtainable after repeated crystallisation of cholesterol

acetate is 115·2; but using the digitonin method and recrystallising only twice, one normally obtains a figure of 116 or higher when 15 or 20% of vegetable fat is present. This test is, of course, absolutely conclusive, as phytosterol does not occur in animal fat. A note describing the method I use for the preparation of the sterol acetate was published in the *Analyst* of September 1933, page 529. The manipulations involved in this test are not easy. The digitonide must be very carefully prepared and the final product amounts to no more than a few milligrams, the melting point of which has to be determined with great precision. The test should not be entrusted to any one but a highly skilled chemist.

It should be noticed that butter is quite as commonly adulterated as ghee and that those members of the public who believe that they are protecting themselves when they have their ghee made from butter in their presence are living in a false paradise.

In some provinces so-called standards have been prescribed for ghee and butterfat. These usually include a minimum Reichert Value but sometimes figures for Refraction, Saponification value, etc., are included. On my advice no such standards have been prescribed in Madras; I believe them to be worse than useless. Owing to the variation of the figures given by genuine ghee it necessarily follows that there must be many adulterated samples which would satisfy standards based, as such figures must be, on minimum values, and, in such cases, to counter the presumption of genuineness it is necessary for the analyst either to attend Court or to give a lengthy explanation in his certificate which, though understandable to a chemist, can only confuse the mind of a lay Magistrate. I am assuming that no responsible chemist would allow himself to be converted into a kind of chemical sorting machine, passing or condemning samples according as they are inside or outside the prescribed minimum limits.

Oils.—In the Madras Presidency the most popular oil is gingelly oil. This is commonly adulterated with groundnut oil. The estimation is very simple. It is carried out by the method of Franz and Adler, as quoted by Evers in his paper on the determination and estimation of arachis (groundnut) oil, *Analyst* 1912, page 488. Genuine gingelly oil, by this method gives a turbidity at 20°C., arachis at 40° and as the increase in the temperature of turbidity is directly proportional to the amount of arachis oil present it thus supplies a figure from which the latter is easily calculated. Recently a number of samples of coconut oil have been found to be heavily adulterated with mineral oil.

Tea.—Standards for tea are similar to those in other provinces. Their effect is to prohibit foreign leaf and excess amounts of dust and sweepings. At one time tea was heavily adulterated. Now the great majority of samples are genuine. This is probably due to the activities of the Tea Cess Committee which include not only propaganda but also the sampling and examination of a large number of samples.

A common adulterant of tea dust is black gram husk. Leaf tea has been adulterated with foreign leaf. For microscopic examination the tea is boiled with a small quantity of 10% sodium hydroxide and then washed by decantation with hot water. Under the microscope the structure of the leaf then becomes quite clear. The husk of black gram is easily identified by its characteristic appearance. Husk is estimated by the ordinary methods which will be found in text-books under pepper. When foreign leaf is present a determination of caffeine is necessary.

Coffee.—Coffee is largely adulterated. The commonest adulterants are chicory and Bengal gram. Chicory is estimated by text-book methods. Bengal gram is easily identified under the microscope after the sample has been cleared with sodium hydroxide. To estimate it a determination of caffeine is necessary.

The Occurrence of Mica-Pegmatites around Gurpa, Gaya.

By M. P. Bajpai.

(Geological Laboratories, Benares Hindu University.)

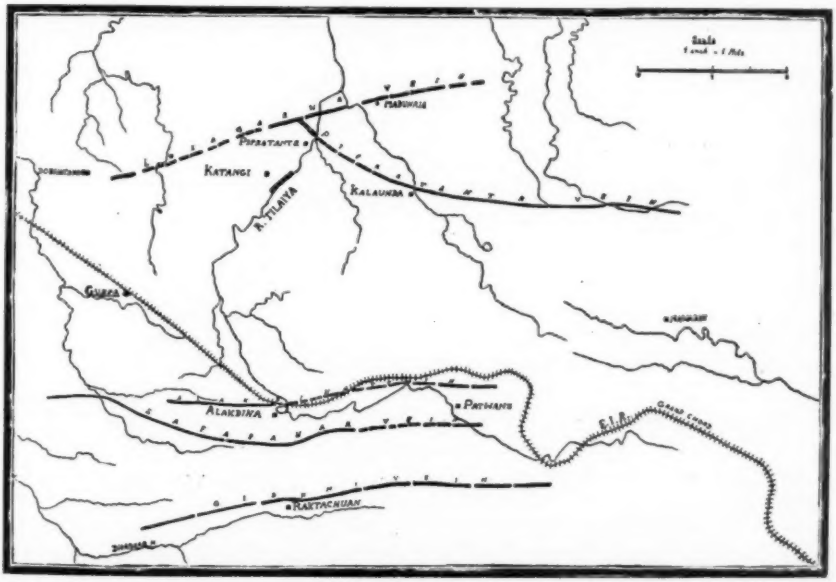
SEVERAL veins of mica-pegmatites occur near Gurpa, a small railway station on the Grand Chord line of the East Indian Railway, about thirty miles south-east of Gaya. The veins were first noticed by the author in 1931 and a paper, "On the occurrence of Mica at Gurpa, Gaya" was read before the Geological Section of the Indian Science Congress at its Calcutta session in January 1935. Recent work on these pegmatitic veins has definitely established the presence of marketable mica in them. A brief description of the area is given below. Granites, gneisses, quartzites, mica-schists and an amphibole schist are the chief "Country" rocks of the area. Among mica-schists a quartz-muscovite schist is of common occurrence. It consists wholly of quartz and muscovite, the former predominating over the latter. Granites and gneisses form nearly all the conspicuous hills of the country, the Gurpa hill being the most prominent.

The country rocks are traversed by mica-bearing veins, of which five are more important. For the sake of description these five have been given the following names :—

South of the Railway line	1. The Gidhni vein 2. The Safa Pahar vein 3. The Alakdiha vein
North of the Railway line	4. The Lohagarwa vein 5. The Pipratantr vein

Veins South of the Railway Line.

(1) *The Gidhni Vein.*—Several small veins and lenticular masses of mica-pegmatites running east-west occur in the southernmost part of the country. Some of them are found at the top of the hill range which marks the boundary between the Hazaribagh and the Gaya Districts, while others are found at the foot and on the slopes of this range. They occur either along the broken line shown on the map or a little to its left



Map of the Country around Gurpa showing the Distribution of Mica-bearing Pegmatites.

or right. Probably, all these outcrops are connected with one another and some of them form parts of the same vein. Quartz-muscovite schist and biotite granite are the predominating "Country" rocks in this part of the area. Only those pegmatites are rich in mica which traverse the quartz-muscovite schist. A trial pit was sunk at the top of the Gidhni Hill near the contact of the pegmatite with the quartz-muscovite schist. At a depth of about 35 ft. several good samples of ruby mica measuring up to 30 sq. in. were obtained. Generally the plates are very lightly stained.

(2) *The Safa Pahar Vein.*—The vein was first observed in a level country west of the Safa Pahar. It was traced eastwards for a distance of about four miles. It runs through the Safa Pahar in the form of several ramifying branches containing no mica. After traversing the Safa Pahar it again outcrops in a level country for some distance, and probably extends upto the village of Patwans. From a trial pit about 20 ft. deep west of Safa Pahar good plates of green mica measuring upto 14 sq. in. were obtained.

(3) *The Alakdiha Vein.*—A well-exposed outcrop of this vein is seen in a level country west of the Alakdiha Dam. West of the dam it was traced for about two miles. On the east an outcrop of pegmatite was seen in the northern outskirts of the village of Patwans. The trend of this outcrop suggests that, probably, it forms the eastern extension of the Alakdiha vein. This vein also contains green mica. The plates are lightly stained and measure upto 20 sq. in.

Veins North of the Railway Line.

Besides the Lohagarwa and the Pipratantr veins several pegmatite lenses occur in the bushy jungle east of the Tilaiya Nala. A small vein runs along the Nala on its left bank about a quarter of a mile east of Katangi.

(4) *The Lohagarwa Vein.*—For the greater part of its length it runs under alluvium and it is only at a few places that it is exposed at the surface. Its best exposure is seen near the confluence of the Kalaunda stream with the Tilaiya Nala, where it traverses mica schists. East of Madnuria it cuts through granite and contains no mica. Recently a mine has been opened about a mile north of Lohagarwa. It has already been worked successfully upto a depth of about one hundred feet. The grades of mica plates which are amber coloured vary from Mica No. 2 to No. 7.

(5) *The Pipratantr Vein.*—The best exposure of the vein is near Pipratantr where it crosses the Tilaiya stream. Here it is above 100 ft. wide and cuts through gneisses and schists. South-east of the village of Pipratantr it is concealed by alluvium for some distance. A tributary of the Tilaiya exposes it near Kalaunda. East of this village it cuts through granite and is seen running on the northern slopes of the Kalaund-Labni Hills for a few miles. West of the Tilaiya Nala it again gets covered up by the alluvium. It contains ruby mica of good quality. A mine has been opened near Pipratantr on the left bank of the Tilaiya stream. The output of mica from this mine is very satisfactory.

Besides the pegmatite veins described above, several apophyses occur in the country forming a sort of network at several places. The thickness of the veins varies from a few feet to more than a hundred feet and no vein maintains a uniform thickness along its course. This is due to the occurrence of several lenticular masses of mica-pegmatites in the same vein. In the veins these lenses of pegmatite are connected with one another either by a narrow band of pegmatite itself or by that of quartz.

Numerous facilities for mica mining can be had around Gurpa. The greatest advantage, which the area offers, is easy transport, as the veins lie close to the Gurpa Railway Station. The adjoining forests abound in good sal-timber and skilled labour is available in the neighbouring villages. The results of trial pits, the profitable working of the two mines which have been opened in the area, the good quality of mica and the facilities for mining available in the neighbourhood, point to a promising prospect of mica-mining in the area.

According to Holland,[1] the Bihar mica belt extends from Jhajha to Bendi (Hazaribagh District) in the west, while

[1] *Mem. G. S. I.*, **34**, Pt. 2, 45.

Fermor[2] states that Chauparan is the western limit of the belt. The Gurpa mica field lies to the west and north-west of Bendi, the distance between Bendi and the western limit of the Gurpa field in its southern part being about ten miles. The north-western face of the area is about 14 miles to the north of Chauparan.

With a view to determine the suitability of the felspar of the Pipratantr vein for use in ceramic industries a specimen from the left bank of the Tilaiya Nala near Pipratantr was analysed for its iron and alkali contents. It was found to contain 0·07 per cent. of Fe_2O_3, 12·85 per cent. of K_2O and about 4·08 per cent. of Na_2O. Experiments made in the Department of Ceramics of the Benares Hindu University show that the felspar is of good quality and can be used in glass and ceramic industries.

[2] *Rec. G. S. I.*, **53**, Pt. 3, 288.

OBITUARY.

Mr. J. H. Field, M.A., C.S.I.

THE death of Mr. J. H. Field, M.A., C.S.I., is a great loss to Meteorological Science. He was the Head of the Indian Meteorological Department from 1924 to 1928.

Before Mr. Field entered service in India in 1904, he had already achieved distinction during the Boer War by devising an automatic alarm fence which, on contact, lit flares and rang alarms in block houses. In order to gain first-hand information of the intricacies of upper air soundings, he undertook a balloon voyage at Lindenberg and also learnt the technique of kite flying. At that time Mr. W. H. Dines had just started his, now famous, upper air investigations in England and Mr. Field was not slow to realise the value of this important work. He devoted some time with Mr. Dines to gain an insight into the problems of the upper air. It is probably correct to say that in India Mr. Field was the first to send up kites fitted with temperature and humidity recording instruments. In 1905, while testing his kite-winch machines at Karachi, Mr. Field discovered that above the surface layer of moist air in that region there was a dry and warm current. During the next two years, kite experiments were undertaken at Belgaum. Mr. Field was not satisfied with these desultory observations and took short leave for a voyage across the Bay of Bengal with a view to carry out upper air soundings in that great laboratory of Indian cyclones. It was always a pleasure to listen to the various anecdotes of his quaint experiences while flying kites at various places.

Mr. Field, as a born experimentalist, had to struggle hard between his own natural inclination of working in laboratories and workshops and the high sense of administrative responsibility as an officer of the Department. He, however, never could forget his ideal, namely, upper air research and amid his less interesting adminstrative duties managed to improvise a small workshop in Simla. In this ill-equipped place he designed some very light recording instruments for use with his kites. This was a noteworthy achievement. He also overcame serious difficulties in the measurement of winds in higher altitudes under Indian conditions. The rubber balloons used in Europe rapidly deteriorated in the tropics. After a very patient testing of various kinds of materials he substituted gutta-percha and celluloid balloons in place of rubber. His activities, however, were perforce limited on account of financial difficulties, as the Government in those days was not in a position to realise the importance of upper air research. Things looked very gloomy indeed and between 1910–12 Mr. Field, in sheer despair, was seriously contemplating resignation. It was chiefly through the good offices of the Royal Society through the Secretary of State for India, that eventually three lakhs of rupees were sanctioned specifically for upper air research and Mr. Field selected Agra as the venue for his experimental and investigational activities. This is the history of the establishment of the Ærological Observatory at Agra in 1914 with Mr. Field as its first Director. It was here that his special aptitude for

experimental work found full scope and Mr. Field laboured incessantly for a decade to adapt experimental methods of the West to suit Indian conditions. It is to him that we owe the splendid collection of standard meteorological data of the upper layers of the free atmosphere over India. His investigations on the relation between the monsoon and the upper winds and the standard exposure of instruments in India will long be remembered in the meteorological history of India.

Mr. Field's activities were interrupted by the Great War during which he went to Britain and joined the Admiralty Research Station at Shandon, Scotland. Here he designed an electrical depth recorder for paravanes on mine sweepers. After the conclusion of the War, Mr. Field returned to India and resumed his upper air investigations. In 1922 his services had to be requisitioned in the Director-General's Office at Simla. Mr. Field knew that his duties would be mainly administrative but did not flinch. On the contrary he brought with him his impressive enthusiasm and convincing advocacy to lubricate the adminnistrative machine at Simla. Mr. Field's predecessor in the Office of the Director-General was Sir Gilbert T. Walker, a mathematician of repute. Under Sir Gilbert's direction the mathematical and physical work done in the India Meteorological Department had received world-wide recognition. It was in the fitness of things therefore that, after the retirement of Sir Gilbert, the mantle of the Director-Generalship fell on Mr. Field, a born experimentalist.

Mr. Field did not relinquish his meteorological work even after his retirement. His services were requisitioned by the Air Ministry, London, to investigate the cause of the so-called "Gibralter plume". In this work also he exhibited his characteristic thoroughness and foresight by preparing a clay model of Gibraltar and experimenting with it in a wind tunnel before proceeding to determine the characteristics of the wind circulation on the spot.

His example has been a constant source of inspiration to the staff of the India Meteorological Department who received such guidance in a critical time of intense activity as financial facilities allowed. For this service alone the Indian Meteorologists can never be sufficiently grateful to him. The India Meteorological Department will ever remain indebted to Mr. Field for the tireless patience and critical acumen which have characterised both his scientific and administrative activities.

Nanga Parbat Expedition, 1937.

As we go to the press, our attention has been drawn to an Associated Press message dated June 20th, concerning the ill-fated Nanga Parbat Expedition which was overwhelmed by an avalanche. Eight of the nine climbers, including the intrepid mountaineer leader Dr. Wien, perished. Nine Gurkha porters are also reported to have been killed. The news of the disaster will be received with the greatest dismay; the mountaineer experts opine that the season was not propitious for the ascent of the peak which is considered more accessible in autumn.

Two unsuccessful attempts on Nanga Parbat (26,629 feet) have been recorded. The first of these was made in 1895, and the second in 1934. The latter was led by Willi Merkl. The present expedition arrived in Bombay on April 30, and established their base camp at an altitude of 10,650 feet on May 18. Camp 2 was reached on May 25 but owing to the unfavourable weather conditions the climbers had soon to return to the base camp. Weather having improved they proceeded rapidly reaching camp 2 on June 3, camp 3 on June 4 and camp 4 on the next day.

The porters all belonged to the Himalayan Club and had been on several expeditions including the Everest.

The members of the ill-fated expedition included Prof. C. Troll and Dr. H. Hartmann, eminent geologists who proposed to collect scientific data during the climb.

LETTERS TO THE EDITOR.

Some New Features in the Activated Accumulation of Solute Molecules at Surfaces of Solutions.

When the surface of a solution of benzopurpurin is allowed to age, an adsorption film develops which has some properties similar to those of the films of insoluble substances studied by Langmuir, Adam and others. This novel phenomenon, first observed in this laboratory[1] has been successfully interpreted as a case of activated accumulation.[2] The same phenomenon has later been observed by McBain and Wilson with soap solutions[3] and by Florence, Myers and Harkins with lauric acid solutions.[4] The present author has continued the experiments on the rate of accumulation and the time-variation of surface tension with solutions having different concentrations of benzopurpurin from M/625 to M/5,000. The results disclose some new and interesting features of the phenomenon. First, the application of Langmuir theory of adsorption to the process of accumulation shows that the solute molecules in the adsorption film try to remain whipping and whirling whenever there is enough free space to do so, thereby increasing their sphere of action in inhibiting accumulation. The effect of varying the concentration is also of interest. In the more dilute solutions, there is a rough proportionality between the rate of accumulation and concentration. At higher concentrations, however, there is an abnormally high enhancement in the rate of accumulation which is possibly to be connected with the polymerisation of the dyestuff. The study of the variation of surface tension with time (by the new technique described by the author[2]) of an M/1,000 solution of benzopurpurin shows a behaviour similar to that exhibited by the lauric acid solution,[4] with a few differences. The surface tension falls sharply (though only to a small extent) in the first instance, falls slowly thereafter for half an hour, then falls rapidly for the next half hour and finally tends to attain the equilibrium value. The details of these observations as well as their interpretation will shortly be published elsewhere.

K. S. Gururaja Doss.

[1] Doss, *Curr. Sci.*, 1935, **4**, 405.

[2] Doss, *Proc. Ind. Acad. Sci.*, 1936, **4**, 97.

[3] McBain and Wilson, *J. Am. Chem. Soc.*, 1936, **58**, 380.

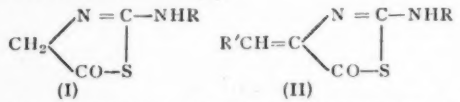
[4] Florence, Myers and Harkins, *Nature*, 1936, **138**, 406.

Influence of Double Bond on the Stability of Heterocyclic Compounds.

Ingold[1] brought forward evidence to show that the presence of a potential semi-cyclic double bond, whilst hindering the formation of smaller rings, should promote that of seven- and eight-membered carbon rings. It has been thought worthwhile to examine, in a number of cases, how the stability of a heterocyclic compound is influenced by the introduction of a double bond just outside the ring.

It is now observed that the introduction of a double bond just outside a heterocyclic ring of the type (I) decreases the stability of the ring. The thiazole (I) condenses

with aldehydes to furnish the compound (II).[2] Both these compounds are hydrolysed by alkali to the corresponding acids. A comparative study of the rate of hydrolysis definitely shows that the compound (II) is less stable than (I).



In contrast to the above observation, it has previously been found[3] that the compound (IV), obtained by the condensation of the thiohydantoin (III) with aldehydes, is much more stable towards alkali than (III). It was further observed that, although the thiohydantoin (III) exists in the thio-thiol tautomeric forms, the compound (IV) exists only in the thiol form. This observation shows that, in all probability, a relationship exists between the internal strain in the ring (IV) consequent upon the introduction of a double bond just outside the ring and the tendency of the ring to acquire a double bond for becoming stable.

My thanks are due to Prof. P. C. Guha for his kind interest in this investigation.

TEJENDRA NATH GHOSH.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
June 6, 1937.

[1] *J. Chem. Soc.*, 1921, **119**, 309.
[2] Ghosh, *J. Ind. Chem. Soc.*, 1937, **14**, 113.
[3] Ghosh, *ibid*, 1934, **11**, 26-27.

6-Aceto-7-hydroxycoumarin.

THE condensation of resacetophenone with malic acid and sulphuric acid has been described by Aggarwal and Dutt[1] who obtained in this reaction the substance figures in the title. Ray, Vaid and Silooja[2] have indicated the formation of this substance in very small yield by the Fries' migration of 7-acetyloxycoumarin. Joshi[3] has described this compound in detail.

The condensation of resacetophenone, malic acid and sulphuric acid at all temperatures between 90 –130° gives 7-hydroxycoumarin by the extrusion of the aceto group from the nucleus, a fact which we have established by a mixed m.p. determination with an authentic specimen. At lower temperatures, the only isolable product is unchanged resacetophenone, which as isolated from the reaction mixture melts at 139° instead of 142°. The substance described by Dutt and Aggarwal also melts at 139°. This substance shows no lowering in m.p. when mixed with a genuine specimen of resacetophenone. It may be stated that resacetophenone requires C, 64·0% whilst the substance m.p. 139° was found to have C, 64·5%. This fact also supports the view that the compound described is impure unchanged resacetophenone.

K. N. GAIND.
S. K. GUPTA.
J. N. RAY.

University Chemical Laboratories,
Lahore,
May 20, 1937.

[1] *J. Ind. Chem. Soc.*, 1937, **14**, 109.
[2] *J. Chem. Soc.*, 1935, 813.
[3] *Proc. Ind. Sci. Cong.*, 1937, Hyderbad Session.

Enzyme Method for the Estimation of Adrenaline from Suprarenal Glands.

ADRENALINE, the active principle of the suprarenal glands, owing to its ease of oxidation by oxidising agents, has given rise to a number of methods for its analysis. It has been observed that the oxidase prepared from the seeds of *Dolichos lablab* has the property of oxidising adrenaline to a red coloured compound and based on this observation a colorimetric method has been developed for its assay. Recently Blaschko, Richler and Schlossmann[1] decteted the presence of adrenaline oxidase in liver and kidney of rats, rabbits and guinea-pigs.

During the course of investigation on the action of the oxidase on adrenaline, it was observed that (1) colour formation takes place between pH 4·4—7·6 and the colour is more stable in the acid range, (2) colour develops within 20 seconds, and (3) a good proportionality exists between different concentrations of adrenaline, and the intensities of colour developed.

The method was applied for the estimation of adrenaline in fresh suprarenal glands.

Fresh glands from dogs and monkeys were extracted with N/10 HCl. and proteins precipitated by the addition of 10% sodium acetate and heating. The solution was filtered and the filtrate made up to a known volume. 5 c.c. of the solution was mixed with 2 c.c. of M/2 phosphate buffer (pH 6·0), 3 drops of 1% H_2O_2 and 2 c.c. of enzyme solution. The colour developed within 1 minute, which was then compared with the standard. Results obtained by the enzyme method were then compared with those obtained by the blood-pressure method. Table I incorporates the data.

TABLE I.

Animals		mg. of adrenaline per 1 gm. of fresh gland	
		Enzyme method	Blood-Pressure method
Monkey	1 ..	1·26	1·29
	2 ..	1·64	1·48
	3 ..	0·66	0·59
	4 ..	1·67	1·67
Dog	1 ..	0·48	0·49
	2 ..	0·50	0·50
	3 ..	0·44	0·54
	4 ..	0·33	0·34

It will be seen from the table that the two sets of results show a good agreement.

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Department of Pharmacology,
Haffkine Institute,
Bombay,
June 1, 1937.

[1] *J. Physiol.*, 1936, **89**, 5.

Anthracnose of Cucurbits in the Punjab.

SEVERAL cucurbits are grown in India as vegetable crops both in the *kharif* and the *rabi* seasons but anthracnose due to *Colletotrichum lagenarium* (Pass.) Ell. et Hals., [= *Glomerella lagenarium* (Pass.) Stevens] which is supposed to be co-existent with its hosts, has not so far been reported to occur in this country. Uppal, Patel and Kamat[1] mention *Glœosporium* sp. on *dudhi* (*Lagenaria leucantha* Rusby). As it is very difficult to distinguish between the genera *Colletotrichum* and *Glœosporium*, it is possible that the fungus mentioned by Uppal *et al.* is *C. lagenarium*. Aside from this, the writer has not so far come across any other published report regarding the occurrence of this disease in India.

In April 1937, the writer found that severe damage was being done to *kakri* (*Cucumis melo* L. var. *utilitissimus* Roxb.) and *kaddu* (*Lagenaria vulgaris* Seringe) in fields near Ferozepore in the Punjab. Nearly an eighth of the crop had already been destroyed and the disease was spreading rather alarmingly. In newly attacked plants small yellowish to brown spots were manifest on the lamina of the leaves and in advanced cases large brown areas with dead, cracked centres were noticed Many of the leaves, especially the young ones, were crinkled and distorted and had a scorched appearance in the dead plants. Similar elongated lesions were present on the petioles and the stems. Fruits were just beginning to form and, in affected plants, many of them showed sunken, water-soaked cankers which were oval to longish. In advanced cases the plants were outright killed and there was every chance of loss of the entire crop.

Fig. 1.

Anthracnose of cucurbits showing lesions on leaves and stems, and cankers on young fruit. Note crinkled and distorted leaf.

About five days previous to this, the crop was very promising but the rains in the early part of April seemed to have started "infection centres" and within these few days much loss had already been inflicted. According to the farmer this same disease

had been observed in previous years but it had usually appeared much later, when part of the crop had already been harvested. This year, however, it had appeared very early, even before the fruit had started forming. The crop was watered from a well and the disease generally followed the course of the irrigation channels.

The symptoms of the disease very closely resembled the description of cucurbit anthracnose given by Gardner.[2] Acervuli were abundant but setæ were rather rare. Spores were one-celled, hyaline, oblong to ovate-oblong and slightly pointed at one end with two or three vacuoles. Spores formed on the plants had a range of 12–27 × 4–6 μ with a mean of 16·5 × 5·1 μ, the range given by Gardner being 13–19 × 4–6 μ. The spores of the Indian fungus are therefore slightly longer than those of the American fungus.

The disease has been shown to be seed borne in the U.S. Experiments to determine the host range, seed treatment, sprays, etc., have been undertaken. The photograph shows lesions on the leaves and stems, and cankers on the fruit.

B. B. MUNDKUR.
Imperial Agricultural Research Institute, New Delhi,
April 27, 1937.

[1] Uppal, B. N., Patel, M. K., and Kamat, M. N., "The Fungi of Bombay," *Bombay Dept. Agri. Bull.*, 1934, 176.

[2] Gardner, M. W., "Anthracnose of cucurbits," *U.S.D.A. Bull.*, 1918, 727, 1–68.

Mutations in Gram *Cicer arietinum* L.

IN the bulk-plots sown with Pusa gram Types 17 and 25 at Karnal,* two mutations were observed in the year 1934. A brief description of these is given below.

Mutation in Pusa Gram Type 17.— The most striking feature of this mutant is its simple leaves unlike the compound leaves of gram Type 17 (Figs. 1 and 2). The leaf-blades show a few deep incisions which in some leaves reach almost the mid-rib, dividing the lamina into lobes. The lobes are joined at the base. The leaves on the main axis exhibit deeper incisions than those on the branches. The shape of the first leaf on the branches is constant. Here the incisions are few and the apex is round. The

Fig. 1. Mutant in Type 17 gram.

Fig. 2. Type 17 gram.

shape of the leaf-blade in other leaves is very variable. The stipules are green leafy structures and are either free from the lamina or jointed to it on one or both sides. In the plants of Type 17, the stipules are free from the leaf-blade. The mutant plants are semi-spreading and more open than those of Type 17. The lower branches have a tendency to grow longer than those arising from upper nodes.

The flowers, pods and seeds do not differ from those of Type 17.

Mutation in Pusa Gram Type 25.— This mutation is equally interesting. The leaf, which again is the part affected, is compound, pinnate and stipulate. The leaf-size is considerably reduced. The leaflets are tiny, and lanceolate to ovate in shape with a serrate margin. The main mid-rib branches into secondary mid-ribs on which are borne the tiny leaflets. In some leaves, the leaflets arise from the tertiary mid-ribs. Towards the tip of the main mid-rib, a few leaflets arise from it and the apex terminates in a solitary leaflet. The leaf stalks are 1·0 to 1·5 mm. in length. The lowermost leaves have longer stalks. The stipules are quite distinct from each other. The branches, the mid-ribs and the leaflets are all hairy. The foliage is dull green. The leaflets on an average are 7·25 × 3·08 mm. in size while those of Type 25 measure 11·1 × 6·5 mm. In habit the mutant plants are bushy and crowded—very different from those of Type 25. The flowers, pods and seeds resemble those of Type 25.

Branches of the mutant and of Type 25 are illustrated in the photograph (Figs. 3 and 4).

* This study was commenced at the Botanical Substation, Karnal, financed by the Imperial Council of Agricultural Research, which was transferred to Pusa in 1936. The assistance of the Council is gratefully acknowledged.

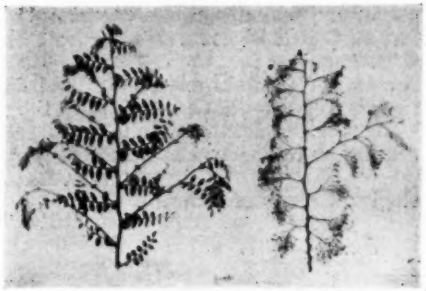

Fig. 3. Type 25 gram.

Fig. 4. Mutant in Type 25 gram.

Further investigations are in progress.

R. B. EKBOTE.

Imperial Agricultural Institute,
New Delhi,
May 19, 1937.

Chromosomes of *Rana tigrina*.

CONSIDERABLE advance has been made during recent years in our knowledge of the Amphibian chromosomes, and several species belonging to the genus *Rana* have been investigated in this direction. But so far as we are aware no report exists up to the date of writing as regards the chromosomes of the well-known Indian species, *Rana tigrina*.* A brief account of our preliminary observations on the chromosomes of this species is presented herewith.

A polar view of the equatorial plate in the metaphase clearly shows 26 chromosomes of different sizes and shapes having V- and J-shape. We have examined several plates showing this stage and in all of them invariably the number of chromosomes is 26 showing the above-mentioned variation in size and shape as shown in the accompanying Fig. 1. All the chromosomes seem to show median or sub-median fibre attachment, since they show constrictions either median or sub-terminal. In this respect, therefore, the Indian species resembles the Japanese forms, *R. nigromaculata* and *R. rugosa* investigated by Iriki[1] and the European form, *R. esculenta* studied by Galgano.[2] However, the Indian frog differs from *R. temporaria*, studied by Makino[3] in the fact that in the latter species there are constantly found two very small grain-like chromosomes, which are absent in the

* See the list by Oguma and Makino, *J. Genet.*, 1932, **26**.

1

2

Fig. 1. Spermatogonial metaphase showing 26 univalent chromosomes.

Fig. 2. Primary spermatocyte metaphase showing 13 bivalents. Camera lucida drawings, magnification being 4200 ×

chromosomal complex of *R. tigrina*, *R. nigromaculata* and *R. rugosa* and *R. esculenta*

In the primary spermatocytes 13 bivalents are seen at the metaphase (Fig. 2), five or six of which are of large size while the remaining are small. All the chromosomes appear thick and much condensed as is generally the case with the majority of Anurans so far studied.

J. J. ASANA.
R. G. KHARADI.

Gujarat College,
Ahmedabad,
May 26, 1937.

[1] Iriki, Sh., *Science Reports of the Tokyo Bunrika Daigaku*, 1932, **B 1**, 61.
[2] Galgano Mario, *Monitore Zoologico Italiano* supp., 1931, **41**, 224.
[3] Makino, S., *The Proceedings of the Imperial Acadamy*, 1932, **8**, 1, 23.

Pearl-like Concretion from a Siluroid Fish.

WHILE investigating the fauna of the Calcutta Corporation Waterworks at Pulta in November 1936, the author had the occasion to collect a large number of dead or dying Siluroid fishes of the species, *Rita rita* (Hamilton) found floating in one of the *pucca* settling tanks which were buried after examination in a pit in the earth with a view to prepare the skeleton. After four months, *i.e.*, in March 1937 while the skeletal remains were being removed from the pit, the author observed a small, bright, salmon-coloured, transparent spherical mass attached to a piece of disintegrated tissue sticking to the skeleton of the dorsal fin. Closer examination showed this to be a pearl-like concretion (Fig. 1) not unlike those from marine fishes in general appearance and structure previously recorded by the author.[1] There were meridional cracks, both superficial and

deep, on the surface of the concretion revealing several concentric layers of apparently chitinous material which were strongly striated in a meridional direction. The

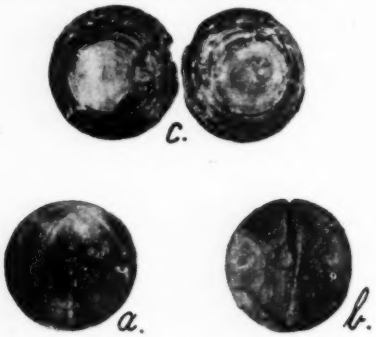

Fig. 1 × 7.

Pearl-like concretion from a Siluroid Fish.

a—Before immersion in water. *b*—After immersion in water for three days. *c*—The inner surfaces of the concretion cut in a slightly excentric section passing through the nuclear part and showing the loose concentric layers composing the concretion.

concretion was 2·8 mm. in diameter, 0·0138 gm. in weight, and had a refractive index of 1·560. The specific gravity was 1·394 when dry and 1·604 after immersion in water for 3 days, showing that the concretion was capable of absorbing a considerable quantity of moisture. After 3 days in water, the concretion showed more longitudinal cracks and splitting of the layers, lost its transparency, and its colour which faded to a dull pale-brown (see Fig. *c*). Although a careful search was made in the pit (containing the skeleton of 18 fishes) for more pearl-like concretions none was found. The formation of such 'pearls' in fish is presumably very rare. The position in which the 'pearl' was found does not imply that there was an organic connection between it and the tissues underlying the dorsal fin, for under the conditions of putrefaction in the pit the 'pearl' may have been displaced from its original location in some other part of the body of the fish, and come to lie on the skeleton of the dorsal fin.

The occurrence of the skeletal remains of a marine Siluroid fish in *Caranx* (*Caranx*) *melampygus* Cuv. Val. from the Andamans (*vide* p. 97 of the reference cited) along with pearl-like concretions, and the present occurrence in freshwater Siluroids of similar 'pearls' seem to suggest that the phenomenon is probably peculiar to the Siluroids, but the present meagreness of knowledge on the subject does not warrant such a conclusion.

The author's thanks are due to his friend, Dr. M. S. Krishnan of the Geological Survey of India, for the determination of the specific gravity and refractive index of the 'pearl'.

H. Srinivasa Rao.
Zoological Survey of India,
Calcutta,
June 4, 1937.

[1] *Proc. Nat. Inst. Sci. India*, 1936, **2**, 93–100, pl. ii.

Influence of the Phenyl and Carboxyl Groups on the Course of Reaction in Walden Inversion Processes.

Contradictions in the empirical generalisations of Frankland[1] and Horton[2] and the inadequacy of the experimental data available to test the rules have already been pointed out.[3] With a view to understanding the influence of the carboxyl and phenyl groups in the course of reaction in Walden inversion processes, substitution reactions with monoethyl-*l*-malate (I), *l*-α-hydroxy-glutaric acid (II), *l*-α-hydroxy-*iso*valeric acid (III), and *l*-α-hydroxy-*iso*caproic acid (IV) have been studied. Substance (I) gave monoethyl-*l*-chlorosuccinate by treatment with thionyl chloride while diethyl-*l*-malate is known to yield diethyl-*d*-chlorosuccinate lending direct evidence to the validity to Horton's rule. (II), (III) and (IV) are found to react with thionyl chloride and subsequently with hydroxylating agents (potassium hydroxide or silver oxide) just in accordance with the requirements of the above rule. The uniform behaviour of a halogenating agent and a hydroxylating agent when employed successively, as observed in the above experiments, also lends support to Horton's generalisation.

The author wishes to express his thanks to Dr. P. C. Guha for his keen interest in the above investigation.

V. Anna Rao.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
June 21, 1937.

[1] Frankland and Garner, *J.C.S.*, 1914, **105**, 1101.
[2] C. L. Horton, *Chem. News*, 1913, **108**, 37.
[3] Anna Rao and Guha, *J. pr. Chem.*, N.F., 1933, **138**, 167.

REVIEWS.

Television Cyclopaedia. By A. T Witts. (Chapman and Hall, Ltd., London). Pp. 151 with 97 figures. Price 7*sh.* 6*d.* net.

To a person writing a book of this kind, the problem is always one of range and selection, of what to include and where to stop. And in the case of television engineering requiring some knowledge of a variety of subjects, for example, optics, fluorescence phenomena, electronics, high-frequency technology, motion-picture engineering practice, electrical engineering, etc., the question of selection is by no means easy. On the whole, the book is fairly comprehensive with its hundreds of items.

Supported by nearly 100 figures, the author gives brief explanations for each item listed in the book; these occupy only one line in some cases and over two pages in others. Brevity is not secured at the expense of clarity; the reader does not get the impression of jerkiness or multilation. The arrangement in alphabetical order is helpful in locating any desired item quickly; and no index is required. On the other hand, it cannot be expected to give a connected account of the subject as a whole.

On pages 133 and 134, it would have been more satisfactory to have written *diffraction* for *defraction*; at the bottom of page 133, *defraction body* is better written *diffracting medium.*

Any one interested in television engineering, will find this book really useful. The printing and get-up leave little to be desired and the price is not excessive. RE.

Culture Methods for Invertebrate Animals. J. G. Needham, Chairman, Committee of Preparation. (Comstock Publishing Co., Inc. Ithaca, New York), 1937. Pp. xxxii + 590. Price 4 dollars.

A compendium of the utmost importance to every zoologist including the modest high school teacher whose sole aim is to thrill his young and eager pupils with the magic of the living and moving animals, has been made possible by the co-operation of a large number of American zoologists, and by a grant of the National Research Council. The idea which originated at one of the meetings of the American Association for the Advancement of Science was taken up by an influential Committee under the chairmanship of Prof. J. G. Needham whose call for co-operation and material met with generous and prompt success. The result has been the production of an immensely important book for which, though the Committee modestly claim only the status of a compendium and the beginning of an effort, is nevertheless a very successful and efficient effort.

Perhaps the most valuable contribution is that embodied in the first part of the work where a general account of the methods of collecting and maintaining marine and freshwater invertebrates is given by the members of the Committee. The importance of this section which includes extremely useful general information is considerably heightened by beautiful illustrative figures of the simple apparatus that one needs to set up in one's laboratory for rearing animals, apparatus which in most cases, one can make for one's self.

The section on the Protozoa is headed by a general account of how cultures of free-living protozoans may be made. Media for chlorophyll bearing animals, for colourless flagellates, ciliates and the Sarcodina are listed. Then follows a series of methods for a variety of protozoans belonging to all orders. A brief account of methods to rear sponges from larvæ as well as from dissociated cells is given, also the raising and care of the common cœlenterates, flatworms and annelids. The section on the Arthropoda is necessarily the longest, that on insects alone extending over 250 pages, the insects of economic importance being treated at great length. Often the methods tried by more than one author are given to enable the reader to benefit by the experience of a variety of specialists in the line. Brief accounts of the methods of rearing many of the common molluscs, echinoderms and ascidians are also given.

In each case, the medium of growth, the food and very often the temperatures at which the cultures give the best results, are given. In many cases, the details of the method of feeding are also noted. Every contribution is supported by a bibliography and sometimes useful cross references to allied species are given. A comprehensive

Index and a list of contributors considerably heighten the value of the work.

B. R. S.

The Spotted Bollworms of Cotton (*Earias fabia* Stoll., and *Earias insulana*, Boisd) in South Gujarat, Bombay Presidency. By B. P. Deshpande and N. T. Nadkarny. (Imperial Council of Agricultural Research, Delhi), 1936. Pp. 208. Price Rs. 6–14 or 9*sh.* 6*d.*

The monograph deals with the results of investigations on the spotted bollworms, financed by the Indian Central Cotton Committee, and carried out at Surat for 8 years from 1923 to 1931. The authors, after mentioning about the occurrence of the bollworms in different parts of the world and in different places in India, give in detail the life-history and habits of the pest after which the types of damage done to the cotton crop are described. The authors also deal with the control methods tried by them such as the removal of attacked shoots, the growing of trap crops, the use of deterrants, attractants and insecticides, parasite liberation and general clean-up measures. In a series of appendices information is given on the spotted bollworms in Khandesh and also on the cotton shoot roller and the pink bollworm.

As a result of their studies the authors state that the pest is active throughout the year and that its life-cycle is completed in 22–35 days. The moths are capable of laying on an average 432 eggs. In South Gujarat, the caterpillars are known to go to the soil for pupation. Both species of *Earias*—*E. fabia* and *E. insulana*—are present, the former predominating. According to the authors, 20–69 per cent. of the shed bolls are found damaged by the worms. Of the several methods tried for the control of the pest they claim that clean-up measures such as the destruction of alternate food plants and uprooting of cotton soon after the *kapas* are harvested with a view to starving the pest during the off-season are the most effective. These are being tried in the Broach District and the results of these trials are awaited with interest.

The authors have given us a good deal of information on the pest. The various plates in the monograph have added to the usefulness of the publication. The results of the investigations are useful not only to those dealing with the cotton crop in South Gujarat but also to others in different parts of India where *Earias* is a pest. The authors are to be congratulated on their publication.

M. C. CHERIAN.

Journal of the Osmania University. Vol. III. (1935. Issued by the Editorial Board, on behalf of the Osmania University Research Board, Hyderabad—Deccan.)

The academic destiny of the Osmania University is entrusted into the hands of a Research Board consisting of representative heads of different departments embraced by the University. Under the auspices of this distinguished body of professors, the University issues an official Journal portraying the results of research work conducted in its laboratories. Although the University is a comparatively young institution, it has already taken an honourable place among the older academic bodies by its activities, which are at once impressive and praiseworthy. We have received a copy of the third volume of the Journal of the Osmania University, which maintains the high standard of scientific and literary excellence established by its predecessors. This University has the unique distinction of using Urdu as the medium of instruction and examination and the foresight of the Government of H.E.H. The Nizam in courageously adopting this experiment is amply justified by the fruitful results already achieved, and practically with unlimited resources at its disposal, the promise of the future is bright and encouraging.

The English division of the Journal contains 8 articles of literary, historical and scientific interest. Dr. R. Siddiqi in his paper "On a System of Non-Linear Partial Differential Equations of Parabolic Types" discusses the generalisation of the method of dealing with the boundary problems of the first and third kinds for single parabolic equations, and Mr. K. R. Rao and Dr. S. Hussain give a historical sketch of the electrodeposition of chromium from potassium dichromate Baths. The article on the Biology, Ecology and Bionomics of the Fauna of Hyderabad State by Mr. M. Rahimulla and Dr. B. K. Das, deals with fresh-water fish and is full of interest. Other equally interesting papers deal with "Meteoric Showers" by Mr. Mohd. A. R. Khan, the influence of nutrition on sexual expression in maize by Messrs. Abdul Bari and M. Abdus

Salam, "The Algal Flora of the River Moosi" by Mr. Ghousuddin and Prof. M. Sayeeduddin, "Indian Thought in English Literature" by Mr. E. E. Speight and "Nadir Shah's Invasion" by Dr. Yusuf Hussain.

Indian Journal of Venereal Diseases. (Quarterly: Editing and Publishing Offices, 94, 97, Girgaum Road, Bombay. Annual Subscription: Indian, Rs. 5, Foreign, 10*sh.*)

This quarterly Journal edited by Dr. U. B. Narayan Rao, supported by an international Board of Editorial Collaborators, is issued from Bombay. Undoubtedly a wide diffusion of knowledge of the venereal diseases whose horrors are as lothesome as their spread is dangerously insidious, must be encouraged in order that the unfortunate victims may obtain timely relief from proper medical treatment. Like tuberculosis, syphilis and gonorrhœa are handed down from antiquity, and their ravages are successfully fought by modern scientific discoveries, but their existence in any community must at all times be a foul blot on the people's moral behaviour. This Journal, the only one of its kind in the Indian Empire, has a message which extends beyond the medical profession, and it should be made increasingly manifest to the general public. We have received the first three volumes of this important Journal, which contain information bearing on the many gruesome aspects of the diseases dealt with by experts, which, however unpleasant, should be widely read. Other sections which are discussed in the Journal are Physiology, Bacteriology and Serology, Radiology and Electrology, Endicrinology, Gastro-enterology, Pneumo-cardiology, Urology, Gynecology, Dermatology, Ophthalmology, Oto-Rhinolarynagology, Odontology, Neurology, Surgery Pediatrics, Eugenics and Birth-control. These subjects give an idea of the range of medical and public interests caused by the Journal, whose career is bound to be bright and successful. The annual subscription is Rs. 5 and the publishing offices are situated in 94–97, Girgaum Road, Bombay.

Application a la chimie des Theories Modernes Sur la structure des molecules. Les Donnees Spectrales. By G. Emschwiller. (Actualites Scientifiques et Industrielles, No. 366.) (Hermann & Cie, Paris), 1936. Pp. 41. Price 12*fr.*

This is the substance of a companion lecture to that of M. Allard (Actualite Series, No. 365). The author starts with our present conceptions of structure of atoms and atomic spectra, and passes by easy stages through the various types of molecular spectra and their interpretation, Raman spectra, molecular vibration frequencies, the excited states of molecules, the phenomenon of predissociation, etc.

In publishing this lecture in book form, the author would have increased its utility, if he had incorporated some important references to original literature or other classical books, so that such of the readers who want to pursue the subject further, could do so easily.

CENTENARIES

S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Bezold, Johann Friedrich Wilhelm von (1837-1907)

BEZOLD, the German meteorologist, was born at Munich on June 21, 1837. He was admitted to the degree of Ph.D. at Gottingen in 1860. He was Extraordinary Professor in the University of Munich in 1866 and Ordinary Professor at the Polytechnic of Munich in 1868.

Meteorological Career

His meteorological career began in 1878, when he undertook the organisation of the Bavarian meteorological service. He remained as the Director of the Central Meteorological Station till 1885, when he went to Berlin as Professor of Meteorology in the University. He organised the Meteorological Institute of Berlin and became its first Director. In this capacity he was for a long period in charge of the climatology, rainfall and magnetic observations of Prussia and also of the aeronautical section at Tegel.

His Writings

He was the author of nearly 75 papers. While most of those related to meteorology and terrestrial magnetism, a few were on

colour vision, the retina and the dust figures of electrical discharge. His classical papers were on the thermodynamics of the atmosphere, and were contributed to the Berlin Academy. In a meeting of the Association of Academies held in London in 1904, he elaborated a proposal for testing Gauss's theory of terrestrial magnetism by measurements along a complete circle of latitude. His collected papers were issued in one volume in 1906.

He died at Berlin on February 17, 1907.

Pearce, Richard (1837-1927)

RICHARD PEARCE, the Anglo-American metallurgist and minerologist, was born near Camborne in Cornwall, England, on June 29, 1837. His father was one of the superintendents of the premier mine of Cornwall. After being at the local elementary school till 14, he went to work in the tin-dressing plant of the mine in which his father was employed. In 1855, his ability found recognition and secured for him the post of Assistant Chemist at the Truro Mining School. Three years later, when the School was closed down, he again joined his father. After a short interval he entered the Royal School of Mines in London and later in 1865 went to Freiburg, Saxony, where he learned silver processes, particularly those of Ziervogel and Augustin.

His Career

On his return from Germany, he built a copper smelting plant at Swansea. But it did not prove a success. In 1872, he sailed for Colorado and took charge of a smelter. He threw himself heart and soul into the work and devised and conducted effective processes, by which he separated no less than 32 tons of gold in his stay of 30 years at Colorado. His process which was a trade secret till 1908, was described by his son that year in V. 39 of the *Transactions* of the American Institute of Mining and Metallurgical Engineers.

His Writings

He wrote more than 30 papers, most of which appeared in the *Transactions* of the Colorado Geological Society, or in the *Proceedings* of the Colorado Scientific Society. His first paper, entitled *Note on chrome iron in the Serpentine of the Lizard*, appeared in V. 9 of the *Transactions* in 1878. These papers were mostly on mineralogy and a few were on geology. The paper, *Note on what appears to be a new mineral from the Gagnon mine, Bute, Montana*, which appeared in V. 2 of the *Proceedings*, was later confirmed by others as a note on a really new mineral.

Pearceite and Pearce Furnace.—This new mineral is a black monoclinic crystal of density 6·15 and of the composition $(AgCu)_{16}As_2S_{11}$. His name has been immortalised in the name of the mineral, which has been fixed as *pearceite*. Another invention of his which bears his name is the Pearce turret roasting furnace, which is said to be the first use of a rotating mechanism to rabble ore during roasting.

His Honours

In 1902, he retired from service and returned to Cornwall. He was doing some professional work till 1919, when he left for London. There he remained near to the museum and the schools of science, both of which continued to command his lively interest at that ripe old age. A Ph.D. degree from Columbia in 1890, a gold medal from the Royal Institution of Cornwall in 1909, and another gold medal from the Institution of Mining and Metallurgy in 1925 were the honours that came to him unsought, "in recognition of the services which he had so long rendered to the advancement of metallurgical science and practice".

He died on May 18, 1927, within a few weeks of his ninetieth birthday.

Snelus, George James (1837–1906)

G. J. SNELUS, the British metallurgist, was born on June 25, 1837, in Camden Town, London. His father, who was a master builder, died when George was seven. He was first trained for the teaching profession. While a teacher near Manchester, he attended lectures on science at the Owens College, Manchester, where he came under the influence of Sir Henry Roscoe. This stimulated in him a great desire for a scientific career. In 1864 he obtained a Royal Albert Scholarship and joined the Royal School of Mines. At the conclusion of his course, he obtained an Associateship in Mining and Metallurgy and the De la Beche medal for mining.

His Career

After being a chemist at the Dowlais Works for about five years, he got, in 1871,

a commission from the Iron and Steel Institute to visit the United States and report on the chemistry of the Danks rotary pudding furnace. His report, which was published in V. 1 of the *Journal* of the Institute, proved of the utmost value. On his return from this commission, in 1872, he was appointed Works Manager of West Cumberland Iron and Steel Co., Workington, of which he later became General Manager and remained as such till 1900.

His Contributions

His chief contribution to metallurgy was in the invention of a process for completely eliminating phosphorus from molten pig iron by oxidation. He got this idea during his investigation in the United States. Having found by experiment that lime could be burned at a high temperature so as to be impervious to water, he conceived the idea of lining the Bessemer converter with lime so over-burnt and thus eliminating phosphorus during the Bessemer process. He succeeded in almost entirely eliminating phosphorus from 3 to 4 ton charges of molten phosphoric pig iron and took a patent. But the process did not become a commercial success till 1879, when Sidney Thomas and Percy Gilchrist perfected it.

Another conspicuous contribution of Snelus to metallurgical chemistry was his proof of the practical value of the molybdate method for the determination of phosphorus in steel, a process which is now universally employed.

He wrote about twelve papers, all of which were published in the *Proceedings* of the Iron and Steel Institute.

His Honours

He was a Foundation Member of the Iron and Steel Institute and its Vice-President from 1889 to the time of his death. He was awarded the Bessemer Medal of the Institute jointly with Thomas in 1883. He was also awarded gold medals for his inventions at the "Inventions Exhibition" in 1885, and at the "Paris Exhibition" in 1878 and a silver medal at the "Paris Exhibition" of 1900. He was made a Fellow of the Royal Society in 1887. He was also an enthusiastic member of the volunteer force from 1859 till 1891, when he received several military honours.

He died on June 18, 1906, aged sixty-nine.

ASTRONOMICAL NOTES.

1. Planets during July 1937.—Venus will continue to be a morning star throughout the month and on July 16, it will closely approach Aldebaran, the planet being $2\frac{1}{2}°$ North of the Star. Mars will resume its eastward motion and although getting fainter, will be a conspicuous object in the evening sky, crossing the meridian about an hour after sunset. On July 17, the Moon occults Mars; the actual occultation will not be visible from any place in India, but the close approach at the time of the setting of the Moon will be worth observing. Jupiter will be in opposition to the Sun on July 15, while Saturn rising about an hour after midnight will be nearly overhead early in the morning, its stellar magnitude on July 16 will be 1·0. Uranus will be about midway in the sky between Saturn and Venus and can be picked up with a binocular.

2. Comets.—Whipple's comet (1937 *b*) is still bright and will pass perihelion on June 20. It is a fairly easy object of about the ninth magnitude in the constellation Bootes. It is slowly moving in a south-easterly direction and can be seen readily with a small telescope. Comet Grigg-Skjellerup was detected by Mr. L. E. Cunningham of the Harvard Observatory on April 30. At the time of observation, it was a faint object magnitude 13 and its approximate position was R.A. 6 *h.* 59 *m.*, and Decl. 7°53′ N. The comet passed perihelion on May 23. It is a periodic comet with a period of 5·0216 years and this is the fifth observed apparition since its discovery in 1922.

3. New Stars.—Nova Herculis (1934) is steady at about magnitude 8·5 with only some small fluctuations in brightness, ranging about half a magnitude. Nova Lacertæ (1936) is slowly declining, its magnitude on June 5 was 10·70. Of the two novæ in Aquilæ discovered by Tamm last year, the first does not show much variation in brightness, but the second nova is definitely fading having declined to the 12th magnitude on June 8.

Some Aspects of the Chemistry of Swamp Soil.

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THE study of swamp soil is of considerable practical importance and has a direct bearing on both agriculture and public health. The related problems are so numerous and so varied in character that they offer scope for all branches of science. Their solution will unravel the mystery which still surrounds the nutrition of the rice plant and will throw fresh light on the nature of life and life processes in the submerged soil.

It will be beyond the scope of a brief review to deal with all the related problems, so the present article is confined to certain chemical aspects having a bearing on the nutrition of the rice plant.

The agricultural operations connected with the cultivation of rice are generally well known and do not require any repetition. It may be pointed out, however, that some of them would require revision, or at any rate, better control in the light of recent scientific findings.

It is generally well known that in certain regions—especially in river deltas—the yield of rice is maintained at a fairly high level though practically no manure is applied. Even in the same locality, certain fields are known to be consistently more fertile than others though they may lie very close to each other. This difference is largely traceable to the extent of deposition of silt, some areas receiving more than others.

The biochemistry of river silt has not yet been adequately studied. The quantity of silt carried by each river, the amount deposited in different seasons, its distribution over the irrigated field, and its contribution to the succeeding crop—all these are important problems which are still awaiting solution. There is no doubt that some of the silts are quite rich and contain over 3,000 parts per million of nitrogen. There is also evidence to show that river silt facilitates oxidation changes.[1] Further studies in this direction may yield highly fruitful results.

In recent years, evidence has been adduced to show that one of the probable causes for the preservation of the fertility of the swamp soil is through fixation of atmospheric nitrogen. The fixation may be in symbiosis with the plant[2] or through the agency of free living organisms.[3] These researches are worthy of extension, with adequate crop experiments to check the various findings. The influence of various external factors—especially deposition of silt—on the nitrogen content of soil should also be determined.

There is evidence to show that, under submerged conditions, the mechanical composition of the soil is altered. The finer fractions tend to increase at the expense of the coarser ones. This has been traced[4] to the decomposition of organic matter (through biological agencies) resulting in the dissolution of minerals (chiefly iron and aluminium) present in the coarser fractions and their subsequent re-precipitation in the finer form. It would be of interest to follow the bearing of this on the increased heaviness observed in some of the areas which have been continuously under rice cultivation.

Some earlier workers[5] have reported that even mere increase in the moisture content of the soil leads to loss of nitrates and even total nitrogen. This is not supported, however, by later researches,[6] which show that when an uncultivated soil or one which has been fallowed for some time is water-logged, there is very little change in total nitrogen. The nitrate content (which is generally small) is further lowered and there is slight increase in nitrites. The most significant change is the production of ammonia, a large part of which is ordinarily retained in the soil sediment: very little passes into the supernatant, so that loss by leaching is comparatively small. If the water level goes down and the soil is exposed to dry, then a considerable part of the ammonia in the soil system is lost by volatilisation.

The mechanism of production of ammonia in the submerged soil has not yet been fully[7] understood. Evidence has been adduced to show that it is derived through degradation of plant residues and disintegration of microbial cells. Although the living organisms do not increase, the enzymes associated with them (especially the deaminase) bring about the desired change. In a manured soil, however, the changes are more complicated, as will be seen in a later section.

In the absence of freshly decomposing organic matter, the biological oxygen demand of the submerged soil is comparatively small. There is slow but steady movement of dissolved oxygen from the surface water into the soil below.[8] The conditions are considerably altered in presence of unrotted organic matter. The dissolved oxygen is very rapidly used up and the medium gets saturated with carbon dioxide and other gases.[9] The conditions become definitely anaerobic, and it is not until the completion of the fermentation that the oxygen of the atmosphere enters the soil system. On prolonged exposure, the dissolved gases pass out into space and aerobic conditions are then restored. In field practice, this process takes 3–5 weeks (depending on the nature of the soil and the amount of organic matter applied) for completion. The land is then fit for the crop.

The production of gases during decomposition of organic matter in the swamp soil has been the subject of a number of enquiries. The most outstanding contributions in the line are those of Harrison and Aiyer.[10] Working with the green-manured soils of South India, those authors showed that the chief gases produced during the fermentation are methane, hydrogen, carbon dioxide and nitrogen. These, on rising to the surface, encounter some active, aerobic bacteria, which oxidise methane to carbon dioxide and hydrogen to water. Carbon dioxide is taken up by the green algæ present at the surface of the soil and oxygen is released.

In this manner, the undesirable gases are removed and only oxygen and nitrogen are evolved from the soil system. Evidence has also been adduced to show that plant roots assist in facilitating oxidation changes in the soil.

Shortly after ploughing in the organic manure (generally a green manure), gas production begins. There is steady evolution over a number of days. The soil is then unfit for the crop : in fact, any that may be planted will be readily killed out. After the initial fermentation has largely subsided, then the algæ become prominent. The oxidation changes reported by Harrison and Aiyer are also noticeable during this period.

The manner in which the rice plant obtains its air supply has interested a number of workers, but no conclusive evidence has so far been obtained. Only the dissolved oxygen of the surface water is available to the root system and it is generally believed that the roots are highly adaptable and can function in the same manner as those of aquatic plants. In this connection, it may be mentioned that the plant thrives well only if a gentle flow of water is maintained. Prolonged stagnation of the surface water affects the growth and depresses the yield. Too great a depth of water is not beneficial to the crop, though certain varieties are able to stand it better than others.

Together with the gases, varying quantities of organic acids are produced in the soil system. The acids are chiefly lactic, acetic, propionic and butyric.[11] The first acid to be formed, and the one which is often produced in the largest amounts, is lactic acid. After a week or ten days, the quantity of lactic acid diminishes and is followed by increase in the other three acids. It may be said, in general, that if air supply is favourable, there is increased production of acetic acid : if unfavourable, greater quantity of butyric acid is produced. The chemical and biological mechanism of the production of acids, as also their bearing on plant growth, are still obscure.

Several workers[12] have drawn attention to the adverse effect of applying nitrates, especially during the puddling period, to the swamp soil. This is largely due to the formation of nitrites in the presence of fermentable organic matter. It is stated that nitrites are highly toxic if present in more than minute quantities. In addition to this, a considerable part of the soluble nitrogen will be immobilised and thus rendered non-available (at any rate for the time being) to the crop.[13]

It has been suggested that, in presence of undecomposed organic matter, the added nitrate may undergo denitrification in the swamp soil. Nitrogen in elementary form may be lost either through spontaneous decomposition (photochemical or otherwise) or through interaction of nitrites with the amino-bodies that may be present in the soil systems. The extents to which the different types of changes contribute to loss of nitrogen have not yet been assessed. In this connection, attention may be drawn to the work of Fowler and Kotwal[14] who adduced evidence to show that loss of nitrogen through purely chemical changes is negligible.

Most workers[15] are agreed that nitrates should not be applied to the swamp soil in the early stages. At a later period, however, and especially just prior to flowering, the crop responds well to nitrates and increased yields have been reported.

Nitrogen transformations attendant on the decomposition of different organic substances has been studied by a few workers.[16] It has been found that substances with narrow C-N ratios are ordinarily decomposed, rapidly yielding considerable quantities of ammonia. Only small quantities of nitrates are formed. There is also significant loss of total nitrogen. This loss is mostly traceable to volatilisation of ammonia. Similar changes, though less pronounced, occur also under dry soil conditions.[17]

Volatilisation of ammonia and attendant loss of nitrogen can be largely prevented by addition of substances with wide C-N ratios. Thus, addition of powdered lantana or glucose will check the loss of nitrogen from soils receiving rich dressings of urea or dried blood.

When substances with wide C-N ratios are applied, there is very little ammonification and practically no loss of total nitrogen. On the other hand, there is steady loss of carbon until a C-N ratio of about 15–1 is attained. After that stage, both carbon and nitrogen are lost, though comparatively slowly.

Volatilisation of ammonia is not probably the only means by which nitrogen may be lost from the soil system. There are probably number of other ways which have not so far been adequately understood. A great deal of further work is needed before any conclusive opinion can be expressed on the subject. The problem is one of considerable practical importance and it is hoped that, beforelong, it will be possible to organise a co-operative scheme of research (preferably under the auspices of the Imperial Council of Agricultural Research) which will not only throw fresh light on the mechanism of nitrogen loss, but will also lead to the development of new and improved methods of conserving soil nitrogen.

Except for the production of certain gaseous and water-soluble products, the transformation of organic carbon in the swamp soil have not so far been adequately studied. Thus, it will be of interest to determine the nature of the residual organic matter, the quantity left at each stage and the transformations subsequently undergone by it. Some information is available regarding water-soluble substances like cane molasses or urea which, if applied in moderate quantities, are completely decomposed and leave practically no solid residue.[18] The changes undergone by bulky organic manures, which are attacked more slowly, are awaiting elucidation.

In spite of their very great practical importance, mineral transformations in the swamp soil have not so far attracted much attention. It is only in recent years that some work has been undertaken and the available results may be summarised as follows :—There is increased availability of calcium and potassium. This is no doubt greatly facilitated by the decomposition of organic matter and consequent production of organic acids. Availability of phosphorus is also increased. Indeed, Sivan[19] has shown that

ploughing in with green manure is one of the cheapest methods of increasing the availability of rock phosphates. Increasing quantities of certain metallic ions (especially ferrous iron) are also brought into solution.[20] The extent of dissolution of iron is influenced by a number of factors such as the nature of the soil, the chemical composition of the organic matter, reaction of medium, temperature, degree of submergence and such like.[21] In soils which are alkaline or contain useful quantities of lime or other buffering constituents, the iron is precipitated almost immediately after it is brought into solution. In other types of soils (especially acid ones), the iron in solution continues to persist for several weeks. The dissolved iron is present, not as bicarbonate as suggested by some earlier workers[22] but mostly as salts of organic acids. After the subsidence of the initial fermentation and on exposure to air, it undergoes hydrolysis and tends to get oxidised, with the result that iron is deposited in finely divided form as ferric hydroxide. It is this which constitutes the red-brown, fluffy layer often found at the surface of the swamp soil. In addition to this, iron is also precipitated as the carbonate, sulphide or the phosphate. The last reaction involves the removal of a part of the phosphate in solution. The precipitated phosphate is finely divided and is available, at any rate, to the immediate crop.[23]

If present in more than traces, ferrous iron in solution is toxic to plant growth. It would follow, therefore, that the soils in which the iron continues to remain in solution for long periods require some rest before the crop can be planted. On the other hand, the soils in which the iron is rapidly precipitated require very little rest and are suitable for early planting. The right stage for planting is now determined empirically, but it should be possible to develop some simple chemical methods of determining it.

The rôle of the precipitated or oxidised iron has not yet been fully worked out. Being finely divided and intimately mixed with the residual organic matter, it should be highly potent in bringing about oxidation changes and thus increasing the availability of plant food. Some useful evidence in this direction has already been obtained.[24]

The transformations of iron may be represented as follows :—

$$\underset{\text{(insoluble)}}{Fe^{\cdots}} \xrightarrow[\text{(In presence of fermentable orgnaic matter)}]{\text{Reduction}} \underset{\text{(soluble)}}{Fe^{\cdot\cdot}} \quad .. \quad (1)$$

$$\underset{\text{(in solution)}}{Fe^{\cdot\cdot}} + \underset{\substack{X_2CO_2 \\ X_3PO_4 \\ \text{(Product of fermentation or already present in soil)}}}{H_2S} \longrightarrow \underset{\substack{FeCO_3 \\ Fe_3(PO_4)_2 \\ \text{(precipitate)}}}{FeS} \quad (2)$$

$$2\,Fe^{\cdot\cdot} + 3O + H_2O \xrightarrow[\text{(exposure to air)}]{} \underset{\text{(fluffy precipitate)}}{Fe_2O_3 \times H_2O} \quad (3)$$

$$2\,Fe_2O_3 + C \xrightarrow[\text{(residual organic matter)}]{} 4\,FeO + CO_2 \quad .. \quad (4)$$

$$2\,FeO + O \xrightarrow[\text{(re-exposure to air)}]{} Fe_2O_3 \quad .. \quad .. \quad (5)$$

Small quantities of aluminium are also brought into solution. It is very difficult to estimate this quantity because even with the least agitation, the dissolved aluminium passes again into insoluble condition. It is then present as an exchangeable base and can be extracted in the usual way.[25] The mechanism of dissolution and the subsequent transformations of aluminium are still awaiting elucidation.

Decomposition of organic matter also facilitates increased dissolution of manganese. At the outset, the manganese of the soil is mostly present as the dioxide, some soils containing more than others. In the reducing atmosphere of the puddled soil and in presence of the acids, the dioxide is reduced and brought into solution in the manganous condition. As in the case of iron, the quantities actually present in solution are determined by a number of factors, the most important of which is the reaction. When the fermentation subsides, manganese in solution is first precipitated and then oxidised to a hydrated oxide. The latter is highly reactive and facilitates subsequent oxidation changes in the soil.[26]

The transformations of manganese and their bearing on the nutrition of the rice plant have not yet been fully worked out. Further work in this direction will lead to highly fruitful results.

Another interesting change, attendant on swamping, is the increased availability of silicon. Application of organic manures (especially green manure) further improves the availability. Since the rice plant (especially the straw and the husk) is exceptionally rich in silicon, the increased availability of this element may, at any rate, partly account for the beneficial effect of swamping.[27]

The mechanism of dissolution of silicon has not, so far, been fully understood. It may be mentioned, however, that soluble silicates (which behave in the same manner as colloidal silica) increase the availability of phosphorus. This aspect of the problem has been studied by a number of workers, but the more recent work of Sreenivasan[28] would suggest that silicon acts by combining preferentially with the soil complex and thus releasing phosphorus for the plant. Fermentation of organic matter releases phosphorus and thus produces an effect which is somewhat similar to that of light dressings of alkali silicate.[29]

One of the most striking features about the cultivation of rice is the enormous demand for water. All the superior varieties of rice and, even many of the coarser ones, flourish best only under the conditions of the swamp soil. The crop, by itself, takes very little water—at any rate, no more than most other dry cultivated crops do.[30] It is, nevertheless, a common experience that if the water supply is reduced or the crop raised under conditions of dry cultivation, growth is adversely affected and yield considerably lowered. The available evidence would suggest that swamp soil conditions provide certain constituents which are not, ordinarily, readily available in the dry soil. One of these is silicon, but there are probably great many others which are essential to the rice plant and

are released only under the conditions of the swamp soil. If the nature of these substances can be determined, it may be possible to provide them in comparatively stable forms even under dry soil conditions and thus improve the yield of rice. Intense research in this direction will lead to findings of very great practical value.

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RESEARCH ITEMS.

Boundary Problem in a Non-Linear Partial Differential Equation of the Fourth Order.—Considering the non-linear partial differential equation $\frac{\partial^4 u}{\partial x^4} + \frac{\partial^2 u}{\partial t^2} = p(x, t)u^3$ in the domain $0 \leqslant x \leqslant \pi$, $0 \leqslant t \leqslant T$, the problem is to find its regular solution $u(x, t)$ satisfying the conditions

$u(0, t) = u(\pi, t) = 0$ in $0 \leqslant t \leqslant T$,

$u(x, 0) = f_1(x)$, $\frac{\partial u}{\partial t}(x, 0) = f_2(x)$ in $0 \leqslant x \leqslant \pi$.

This has been considered by M. R. Siddiqui (*Ind. Physico-Math. J.*, 1937, **8**) and it is found that for a restricted T, one and only one solution exists which can be expressed as a Fourier series $u(x, t) = \sum_n v_n(t) \sin nx$, wherein the coefficients $v_n(t)$ are determined with the help of an infinite system of non-linear integral equations, which is solved by the method of successive approximations.

Amphoteric ion.—A review of considerable interest has recently been published (P. Rumph, 'La Theorde de L'ion Amphotere,' *Actualites Scientifiques et Industrielles*, 1936, No. 374). The review covering just 50 pages is divided into three chapters: (1) the existence of amphoteric ions, (ii) the dielectric constants of aqueous solutions containing amphoteric ions, (iii) calculation of the different dissociation constants and the relationship between the activities of the amphoteric ions and those of the uncharged molecules.

In a brief conclusion, the author draws attention to the usefulness of this concept of amphoteric ions in branches of chemistry other than a pure study of biological substances, such as, in the theory of colouring matters, the constitution of complex compounds of inorganic salts, etc.

Histology of the Skin of *Protopterus*.—The African lung-fish, *Protopterus annectens*, is known

for its powers of æstivation during the dry months of the year, when all physiological activities of the animal are in abeyance. G. M. Smith and C. W. Coates (*Quart. Journ. Micros. Sci.*, March 1937, **79**, Pt. III, No. 315) have examined the structure of the skin of the animal during normal life and during æstivation (which they have been able to induce in the laboratory). The difference between the two skins rests mainly in the structure of the mucous glands which are very conspicuous and large in the normal skin while they are shrunken and small in the skin of the æstivating animal. Certain minor changes also occur in the epithelial cells of the skin during æstivation.

Germ-Cell Origin in the Amphibia.—Diversity of opinion, not solely due to differences in interpretation, exists regarding the origin of germ-cells in the adult Amphibia. Whether germ cells that make their appearance periodically during the lifetime of the animal are the derivatives of the original and primordial germ-cells of the embryo or whether they are formed afresh every season, at least in part, of somatic derivatives is the problem. The evidence presented is conflicting. J. W. Burger (*Journ. Morph.*, March 1937, **60**, No. 2) working on *Plethodon cinereus* finds the germ-cell line in this animal continuous and that primordial germ-cells alone give rise to the germ-cells of the adult by repeated divisions, themselves remaining unchanged throughout the lifetime of the animal. No somatic cell of any kind is seen to give rise to germ-cells, either by a direct transformation or by division. Both cytological as well as statistical evidence is put forward for this theory in the paper. The findings of Seshachar (*Zeitsch. Zell.*, April 1937, **Bd. 26**, H. 2) are exactly opposite. In the Cæcilian *Ichthyophis glutinosus*, he finds that practically the only source of the germ-cells in the adult male is the lining of the duct system whose representative vessels ramify throughout the testis and whose cells are constantly seen transforming into spermatogonia. Residual spermatogonia derived from the primordial germ-cells of the embryo and persisting throughout the life of the animal giving rise to functional germ cells, themselves remaining unchanged, are absent in *Ichthyophis*. While it is possible that both kinds of conditions are found in the Amphibia, it is more than likely that the organization of the testis and the pattern of spermatogenesis determine the particular condition found in the animal.

Theileriasis of Cattle in India.—From a study of a strain of Theileria in artificially infected hill bulls Sen and Srinivasan (*Ind. J. Vet. Sci. and Animal Husb.*, 1937, **7**, 15) have concluded that the incubation period lasts for 16 days in artificial infection but the duration of the disease is only 5·5 days in fatal cases and 4 to 17 days in recovering cases. The disease is characterised by high fever, loss of appetite, enlargement of prescapular and precrural glands and yellow and petichæted condition of the visible mucous membranes. Blood examination at the first rise of temperature shows often rare theileria and Koch's bodies or both. The parasites multiply in the course of the disease and attack 50 to 100% of the red blood cells though Koch's bodies may be few or many. Usually the parasites are seen as round forms, "rods" being rare. The mortality is over 75 %.

Twenty different drugs were tried for remedial effects but the results were neither definite nor satisfactory.

The next article which the authors have promised, dealing with immunisation and treatment with Anti-Serum, will be eagerly looked forward to.

S. D. A.

Pneumonia in Foals due to *Corynebacterium equi*.—A particular form of pneumonia is known to occur with some frequency in certain breeding studs in the Punjab, and the etiology of this condition, which was thought to be identical with that described by Magnusson in Sweden, has been under investigation for some time.

The infection is generally confined to foals about one to two months old, and occasionally symptoms of joint-ill may be seen in addition to those of pneumonia. The mortality is high. Post-mortem examination reveals large abscess cavities in the lungs and the mediastinal glands.

Corynebacterium equi, the causal agent, can be recovered in nearly every case in pure culture from the abscesses in the lungs and mediastinal glands, as well as from the fæces, sometimes from the heart-blood and, rarely, from the joint fluid of naturally as well artificially infected cases. The cultural and biochemical characters of this organism have been newly described (Rajagopalan, *Ind. J. Vet. Sci. and Animal Husb.*, 1937, **7**, 38).

It has been possible to reproduce the typical symptoms of the disease by an intra-nasal douche of a saline suspension of the organism. Age, as in natural incidence, appears to be the chief factor in the artificial reproduction of the disease.

S. D. A.

SCIENCE NOTES.

Medical Research in India.—The Scientific Advisory Board of the Indian Research Fund Association has recently published a report in which the results of investigation into the etiology of epidemic dropsy, the causes of maternal mortality, the nutritive value of Indian foods and the incidence of tuberculosis among Indians, are dealt with. Like all scientific publications, the report is technical, but is yet not without interest to the lay reader. During the year under report, further researches into other subjects of equally dreadful interest, such as cholera, malaria, leprosy, plague, cancer and snake venoms were undertaken with particular reference to Indian conditions.

* * *

The Indian Military Academy.—The main object of this institution is to foster in the cadets the qualities of leadership, discipline and physical fitness and to instil in them a high sense of duty, of honour and of patriotism. In order to secure such praiseworthy ideals, a library, a museum and extensive play-grounds are proposed to be added while every opportunity is utilised for enriching and extending the social activities of the Academy. These activities ought to humanise the young cadets, and help them to understand and behave in the proper way in societies differing from their own in customs and behaviour.

* * *

Indian Cotton and Lancashire.—The third annual report of the Lancashire Indian Committee, established by the President of the Board of Trade of Great Britain in the autumn of 1932, records with sense of satisfaction that the takings of Indian cotton by the United Kingdom in the calendar year 1936 should have passed the half million bales mark by a very satisfactory margin. This beautifully got-up document contains valuable tables regarding consumption of Indian cotton, effect of price on demand for Indian cotton, its comparative consumption, imports of raw cotton into the United Kingdom from India and imports and exports of chief commodities. The report acknowledges the indebtedness of the Lancashire Committee to the Indian Central Cotton Committee whose co-operation led to the achievement of such handsome results.

* * *

A Guide to Indian Cottons.—The East India Cotton Association, Ltd., and the Indian Central Cotton Committee, Bombay, have jointly brought out a brochure, under the title of "A Guide to Indian Cottons", with a preface by Sir Purshottamdas Thakurdas, Vice-President of the Indian Central Cotton Committee.

The need for such a brochure is widely felt by those in the Cotton trade.

In view of the fact that Indian cottons are attracting greater and greater attention in the world's markets, the 'Guide' will supply a long-felt want.

The information contained in it has the stamp of authority on it since it has been brought with the kind and full co-operation of the several commercial bodies and the various Directors of Agriculture, all over India.

The technical information given in the brochure was collected by the Technological Laboratory of the Indian Central Cotton Committee situated at Matunga.

A table of the staple length, blow room loss and spinning performance of the various growths of cotton under average mill conditions is given at the end of the book which will be found very useful.

Dealing with the characteristics of Indian cottons under Bengals, Broach, Oomras and Southerns in a detailed manner, the 'Guide' brings out the varying trade names by which they are known in different geographical districts where they are produced.

This information is bound to be very useful to the consumers of Indian cottons both in this country and abroad, in picking up cottons suitable to their particular requirements.

The get-up of the book is quite attractive and it can be had from the Secretary, Indian Central Cotton Committee, Post Box No. 1002, Bombay. It is priced 6 annas.

* * *

Timber for Development of Communication.—In a pamphlet issued by the Forest Research Institute, Dehra Dun, the possibility of employing treated timber for the construction of bridges is discussed as an important part of the rural reconstruction programme. It is claimed that as a result of intensive researches, the Institute has evolved a process of treatment which gives any kind of timber sufficient resistance to the ravages of weather and insect pests and that the impregnated wood offers excellent material for building durable railway and highway bridges. Bridge spans of 100 feet are possible with properly designed timber trusses. Spans up to 350 feet are practicable if the suspension bridge type is employed. 70 to 90 per cent. of the total length of railway bridges of several important systems of railways in the United States of America are of treated timber, and the Howe Truss Bridge at Fresnel, British Columbia, having two spans of 150 feet each and three spans of 180 feet each, is a notable example of treated timber highway bridge. The maintenance of all weather roads in the countryside is an important part of the rural development scheme in India, and easy and safe communications for the rapid transport of agricultural produce are an integral part in the promotion of village prosperity.

* * *

Education in India in 1934–35.—The quantitative increase in numbers of pupils undergoing instruction in Indian schools and colleges of all types is maintained. In 1932–33, this increase was 86,995 and in 1934, it rose to 319,358 while in 1935 it was 333,979 of whom 135,195 were girls and 198,784 boys. From tables published in the report, it will be seen that out of the total number of boys of school-going age who should be in primary schools 50·3 per cent. are enrolled while the percentage for girls is only 16·5. These figures will not satisfy the leaders of public opinion, whose ambition is that every child of whatever sex

and social status, must obtain the rudiments of education in order to take an intelligent and active interest in the civic administration and to exercise the franchise with discrimination, and generally to lead an enlightened and useful life. The report observes that " no provincial ministry since education has become a transferred subject, has had the courage to tackle the evils permanently. They could not reorganise and readjust in the higher stages of the educational system as there are too many vested interests to antagonise, while in the lower stages they have been unable to stem waste and extravagance ". We are not amazed at these criticisms. In our judgment, it was the most egregious blunder to transfer education to provincial ministry and subject its portfolio to the vicissitudes of the political fortunes of party government. Commissions and conferences draw up skilful and learned reports and yet education is the favourite topic of popular criticisms. The report issued by the Government of India is something more than a mere statistical record. *Video meliora proboque, Deteriora sequor* is the motto not only of education but of so many other departments, and India has a genius for seeing and approving better things and pursuing the wrong methods and achieving indifferent results.

* * *

The National Geographic Society, Washington, U.S.A.—The Smithsonian Institution Expedition for the collection of wild animals from the Dutch East Indies, organised by the American Geographic Society, for the purpose of displaying them in the National Zoological Park in Washington, has, through the intrepid zeal of Dr. W. M. Mann and Dr. M. O. Williams, collected numerous birds and scores of mammals. Among the latter are a hog badger, a Sumatran wild dog, a lemur, a martin, a pigmy leopard cat and a baby tiger.

* * *

An ingenious device designed by Dr. Irwine Gardner of the National Bureau of Standards, by means of which the extremely faint, wispy outer portion of the pearly corona of the Sun can be made to register on a photographic plate while over-exposure of the brighter, close-in portion is avoided will be used for the first time by the U.S. Navy Solar Eclipse Expedition on 8th June. The device consists of a flat disc, portions of it cut away, which will rotate between the photographic plate and the " breech " of Dr. Gardner's telescopic camera. The rotating disc has been used in the laboratory work in light measurement, but this will be the first occasion on which it is to be employed to obtain an even exposure of the Sun's corona. The disc is 13 inches in diameter and has a rim, a hub and four blades like the petals of a flower, equally spaced over the disc. There will thus be a great deal of open space near the rim and only narrow openings near the hub. As the disc turns, it will cut out a considerable part of the bright light from the inner part of the corona and will allow all the faint light from the outer portion to get through to the photographic plate. The disc will be kept spinning before the plate by an electric motor at a speed of 100 revolutions a minute. Half the photographs of the corona to be made by Dr. Gardner will be taken with the disc in place, and half without it.

* * *

Dr. Gilbert Grosvenor, President of the National Geographic Society, U.S.A., recently announced that the remote and little-known interior of semi-tropical Kwangsi Province in South China will be explored for new scientific and geographic knowledge by a joint expedition of the National Geographic Society and Lingnan University, Canton. In the Kwangsi hinterland are both plants and people practically unknown to the outside world. This expedition will search for plant-bearing mysterious fruit, only vaguely known to Western science, but reported to be used for medicinal purposes by the Chinese. It is known as Lo Hon Kwoh or Ahern's fruit. The natural history of the region, geological formations, life and customs of the people especially of the aboriginal tribes and the significance of Kwangsi as a transition zone between the Malayan tropics and the highlands of Tibet will also be studied by the Expedition.

* * *

We congratulate **Mr. Hari Ram Sarna** who has just returned from England with a PH.D. from the University College, London. Dr. Sarna has worked with Professors E. N. da C. Andrade, D.SC., PH.D., F.R.S., and A. H. Compton, two of the world's best known physicists. His work on dielectric constants and dielectric dispersion at University College, London, has been highly praised by Prof. Andrade, who speaks of Dr. Sarna as an excellent student with a very sound knowledge.

* * *

Royal Institute of Science, Bombay.—Dr. T. S. Wheeler has been elected additional Vice-President to represent the Indian Academy of Sciences on the Council of the National Institute of Sciences, India.

Mr. M. R. Kapadia will officiate as Lecturer in Physics *vice* Dr. N. R. Tawde, who is acting for Professor G. R. Paranjpe while the latter is on leave.

* * *

Indian Science Congress Association—British Association Delegation to Jubilee Meeting.—*Acceptances to date* 19–5–1937. Baily, F. G., Professor of Electrical Engineering, Heriot-Watt College, Edinburgh. Baly, E. C. C., C.B.E., F.R.S., Professor of Inorganic Chemistry, Liverpool University. Blackman, V. H., F.R.S., Professor of Botany and Director of Biological Laboratories, Imperial College, London. Caie, J. M., Assistant Secretary of the Department of Agriculture for Scotland. Debenham, F., Professor of Geography, Cambridge University. Fearnsides, W. G., F.R.S., Professor of Geology, Sheffield University. Mcfarland, J., Reader in Geography, Aberdeen University. Ogilvie, A. G., Professor of Geography, Edinburgh University. Rendle, Dr. A. B., F.R.S., Formerly Keeper of Department of Botany, British Museum (Natural History), London. Saunders, Miss E. R., Lately Lecturer in Botany, Newnham College, Cambridge. Stratton, F. J. M., Professor of Astrophysics, Cambridge University. Venn, Dr. J. A., President, Queen's College, Cambridge, and Lecturer in History

and Economics of Agriculture. Wynn Jones, Dr. Ll., Lecturer in Psychology, Leeds University. *Acceptances to date* 14–5–1937. Barker, E., Professor of Political Science, Cambridge University. Crew, F. A. E., Professor of Genetics and Director of the Animal Breeding Research Department, Edinburgh University. Howarth, O. J. R., Secretary, British Association for the Advancement of Science.

* * *

We acknowledge with thanks receipt of the following :—

"The Agricultural Gazette of New South Wales," Vol. 48, No. 5.
"Indian Journal of Agricultural Science," Vol. 7, No. 2.
"Monthly Bulletin of Agricultural Science and Practice," No. 5, May 1937.
"Journal of the Royal Society of Arts," Vol. 85, Nos. 4405–4408.
"Biochemical Journal," Vol. 31, No. 4.
"Biological Reviews," Vol. 11, Nos. 1 and 4 ; Vol. 8, Nos. 1–4 ; Vol. 9, Nos. 1–4 ; Vol. 10, Nos. 1–4.
"Journal of the Institute of Brewing," Vol. 43, No. 5.
"The Calcutta Review," Vol. 63, No. 2.
"Chemical Age," Vol. 36, Nos. 930–933.
"Journal of Chemical Physics," Vol. 5, No. 5.
"Berichte der Deutschen Chemischen Gesselschaft," Vol. 70, No. 5.
"Russian Journal of General Chemistry," Vol. 7, Nos. 3–6.
"Journal de Chemic Physique," Vol. 34, No. 3.
"Experiment Station Record," Vol. 76, No. 4.
"Transactions of the Faraday Society," Vol. 33, Part 5, No. 1.
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"Genetics," Vol. 22, No. 3.
"Transactions of the Mining and Geological Institute of India," Vol. 33, No. 1.
"Indian Trade Journal," Vol. 135, Nos. 1612-14.
"Bulletin of Indian Industrial Research," No. 9.
"Marriage Hygience," Vol. 3, No. 4.
"Scripta Mathematica," Vol. 4, No. 3.
"Medico-Surgical Suggestions," Vol. 6, No. 5.
"Review of Applied Micology," Vol. 16, No. 4.
"Journal of the Bombay Natural History Society," Vol. 39, No. 5.
"Nature," Vol. 139, Nos. 3521–24.
"Journal of Nutrition," Vol. 13, No. 4.
"Research and Progress," Vol. 3, No. 3.
"Canadian Journal of Research," Vol. 15, No. 4.
"Journal of Research," Vol. 18, No. 1.
"Science and Culture," Vol. 2, No. 11.
"Science Forum," Vol. 2, No. 2.
"Arkive Fur Zoologie," Band 29, Nos. 1–2.

ACADEMIES AND SOCIETIES.

The Indian Academy of Sciences:

May 1937. SECTION A.—C. DAKSHINAMURTI : *Light-Scattering, Raman Spectra and Allied Physical Properties of Some Essential and Vegetable Oils.*—The results are discussed in relation to the known chemical constitution of the various oils. R. S. KRISHNAN : *Dispersion of Depolarisation of Light-Scattering in Colloids. Part III. Platinum, Copper, Selenium and Tellurium Sols.*—These sols do not possess any region of specific absorption. The factors ρ_u and ρ_v increase towards the ultra-violet, while ρ_h decreases. The particles in these sols must have an appreciable size, spherical in shape. S. RAMA SWAMY AND K. Y. SRINIVASA IYENGAR : *X-Ray Analysis of the Structure of a Fibrous Modification of Tourmaline.*—In the fibrous modification the unit cell dimensions are same as in the unmodified core of the mineral. M. I. HAQ AND R. SAMUEL : *Note on the Absorption Spectrum of Phosphorous Pentaselenide Vapour.* R. SAMUEL AND M. USMAN : *Absorption Spectra of Solutions of Some Halides amd Oxyhalides of S, Se and Te.*—The absorption spectra do not essentially differ from those obtained in the vapour state. T. VENKATARAYUDU : *On the Linear Algebra of Classes of Elements in a Finite Abelian Group.* K. C. PANDYA AND T. A. VAHIDY : *The Condensation of Aldehydes with Malonic Acid in the Presence of Organic Bases. Part VIII. The Condensations of* o- *and* m- *Methoxybenzaldehydes.*—The general expectation that the yields in the case of the condensations of the methyl ethers will be higher is abundantly fulfilled in both the cases. V. R. HEERAMANECK AND R. C. SHAH : *Tautomerism of 2-Phenyl-3-Carbethoxy-4-Hydroxy-Quinoline.*—The quinoline reacts both in the enolic and ketonic forms. R. ANANTHAKRISHNAN : *The Raman Spectra of Crystal Powders. V. Inorganic Nitrates : Water of Crystallisation.*—The complete spectrum of several nitrates are reported for the first time. The spectra of the water of crystallisation in several salts vary very much from substance to substance, both in intensity and sharpness. They are in general between 3150 and 3650 cm.[1] P. S. SRINIVASAN : *The Elastic Properties of Mother-of-pearl.*—The Young's modulus in any given direction diminishes with increasing protein content. A general expression for calculating the elastic modulus of a compound structure in terms of the elastic moduli of component materials and their distribution is derived. B. K. SINGH, K. NARAYAN, P. SINHA, S. PRASAD AND N. CHATTERJI : *The Physical Identity of Enantiomers. Part III.—Viscosities Densities and Refractiivities of* d-, l- *and* dl- *forms of Isonitrosocamphor (Stable and Unstable), Camphor Camphoric Acid, Camphoric Anhydride, Camphorquinone and Sodium Camphorate.*—It is concluded that there is strong evidence for the existence of racemates in solution in all cases.

Indian Mathematical Society:

(*Journal*, 2, No. 5). E. H. NEVILLE: *Bipolar and Trigeminal Coordinates on a Line.*—If P is a variable point on a line AB, the expressions AP^2, BP^2 are called bi-polar co-ordinates. If these are called λ, μ, and if $h = AB^2$, there is a relation between λ, μ, h which can be expressed by saying that the line $\lambda x + \mu y + 1 = 0$ touches the conic $hxy + x + y = 0$. Thus a correlation is established between points on AB and the tangents to a hyperbola. This sets up a correspondence between point-pairs on the line and points in the plane of the above conic. A systematic study of this correspondence forms the subject-Matter of this paper.

MISS. S. PANKAJAM: *On Symmetric Functions of n Elements in a Boolean Algebra.*—If $A_1, A_2, \ldots A_n$ be elements of a Boolean Algebra, let $\beta_r(A_1, A_2, \ldots A_n)$ denote the class of elements belonging to exactly r of the classes A. These functions β_r are considered for different values of r, and various types of symmetric functions formed from the A's by the Boolean operations $+$, $\times$, negation as well as conjunction and disjunction are expressed in terms of the β's.

D. P. BANERJEE: *A Further Note on the Zero of Bessel Functions.*—It is proved that J_n and J_{n+m} have no common zeros except perhaps those at the origin, provided m and n are real,

$|m| < |$, and $n > max\left(\frac{1}{2}, \frac{m^2}{2(1-m)}\right)$. follows that if $|m| < 1$, and m, n be real, $Y_n(z)$ and $Y_{n+m}(z)$ have no common positive zeros except may be those at the origin.

Mathematics Student:

(*Journal*, 4, No. 3). This issue is dedicated to the memory of the late Mr. V. Ramaswamy Aiyar, the founder of the Indian Mathematical Society, and contains a portrait of his later years. Life sketches and reminiscences of this remarkable personality are given by Mr. M. T. Naraniengar, by Mr. S. R. Ranganathan, and by several other gentlemen who had the occasion to move or correspond with him frequently. There are also some articles contributed by him, and the substance of one of his lectures on the Fermat point of a three-point system delivered under the auspices of the Madras University. There is also a paper by Mr. A. A. Krishnaswami Ayyangar, entitled "Geometry of the tricusped hypo-cycloid" which was the outcome as well as the development of certain of Mr. V. Ramaswamy Aiyar's results in the subject. Lastly, solutions to several problems of V. Ramaswamy Aiyar, and some new problems of his in connection with what he has termed the *Durai Rajan point* of a quadrangle are published.

V. RAMASWAMY AIYAR: *The Fermat Point of a Three-Point System.*—If A, B, C be three points, the position (or positions) of P for which the expression $\lambda PA + \mu PB + \nu PC$ is a minimum is the Fermat point (or points) of the system. The problem is to study the position or positions of the Fermat points for varying values of the constants λ, μ, ν. A geometrical study of this problem is explained here, with particular reference to the cases where λ, μ, ν are all positive.

V. RAMASWAMY AIYAR: *Note on a Class of Curves.*—Let R_{2n} be a curve of class $n+1$ touching the line at infinity n times, the circular points being two of the points of contact. The curve is determined when $2n$ tangents are given. We have then the property:

If any $2n+1$ tangents of an R_{2n} be taken, their Clifford-Miquel circle is a straight line.

When $n = 2$, this gives: If any five lines are tangents to a three-cusped hypo-cycloid, their Miquel circle becomes a straight line (given earlier by the author in Question 1250, *J.I.M.S.*).

A. A. KRISHNASWAMI AYYANGAR: *Geometry of the Tri-Cusped Hypo-Cycloid.*—Among the several results, the following may be mentioned here:—

(1) If any transversal cut the sides BC, CA, AB of a triangle ABC at D, E, F, such that $BC.BD + CA.CE + AB.AF = \Omega$ (a constant) (the segments being taken positively in the direction which makes the area of the triangle positive), then the transversal envelopes a fixed tri-cusp inscribed in the triangle ABC. (Qn. 1458, *J.I.M.S.*).

Conversely, if ABC be any triangle circumscribed to a tri-cusp, and any tangent to the tri-cusp meet BC, CA, AB in D, E, F, then $BC.BD + CA.CE + AB.AF$ is constant.

(2) If P_1, P_2, P_3 be the points of intersection of any tangent to a tri-cusp with three concurrent tangents OT_1, OT_2, OT_3 whose points of contact are T_1, T_2, T_3 then

$$\Sigma \frac{OP_1}{OT_1} = 1 \text{ and } \Sigma \frac{1}{OP_1 \cdot OT_1} = 0$$

(3) If the tangents at T_1, T_2, T_3 to a tri-cusp meet in O, the isogonal conjugate of OT_3 in the angle T_1OT_2 bisects T_1T_2 and is parallel to the other tangent from T_3.

(4) Tangent pairs from points on any given tangent to a tri-cusp meet the line at infinity in point-pairs of the same involution, of which the circular points are members. The double points of the involution are the points at infinity on the tangents at the extremities of the tangent chord.

Erratum.

Vol. 5, No. 11, May 1937, page 595 article entitled "A Note on the Hairiness in the Punjab Cottons".—

In place of "By R. S. Jai Chand Luthra"

read "By R. S. Jai Chand Luthra and Indar Singh Chima".

986-37.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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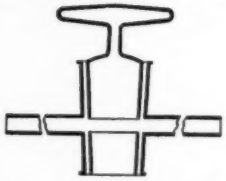

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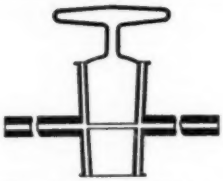

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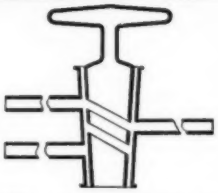

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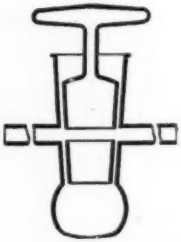

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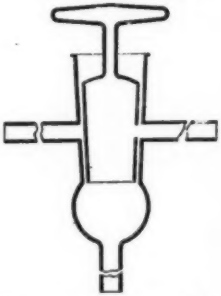

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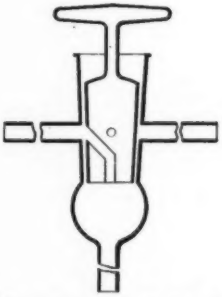

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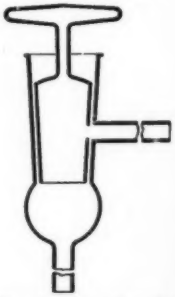

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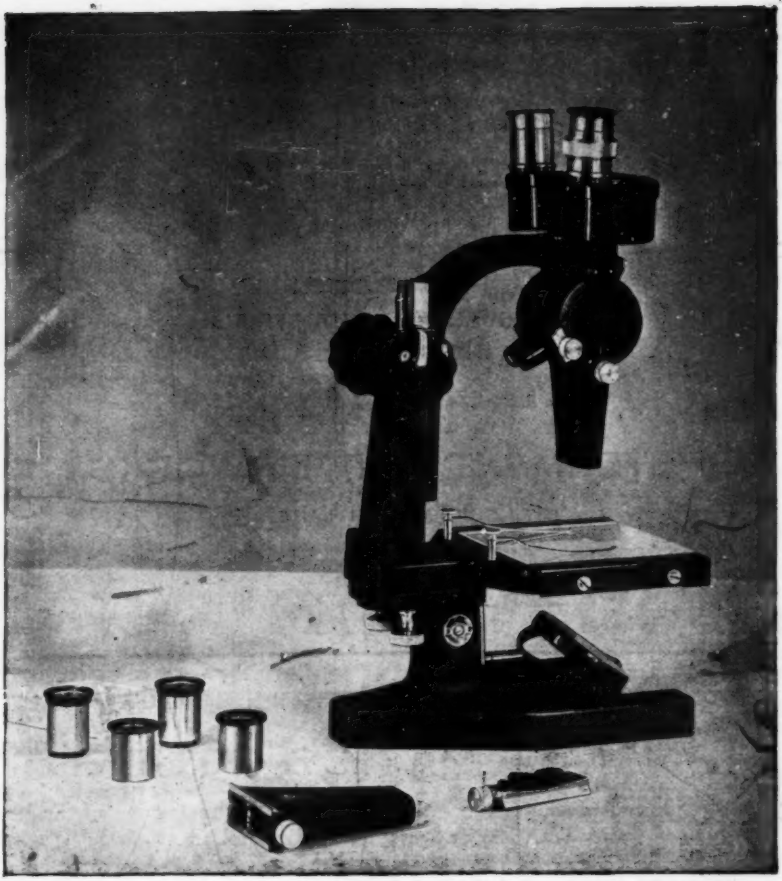

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